# Mobility Transition in Urban Space

## - Mobility Concepts in German Neighbourhoods-

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# Abstract

This thesis examines the effectiveness of mobility instruments in reducing private car dependency within residential neighbourhoods in Germany, addressing pressing environmental and spatial challenges. Grounded in the Avoid-Shift-Improve (ASI) framework, the study investigates which measures can promote sustainable urban mobility transitions and how their effectiveness varies across different neighbourhood types. The central research question focuses on determining the impact of nine selected mobility instruments, such as parking management, neighbourhood garages, bicycle garages, and mobility flat rates, on both restricting car use and promoting a shift towards alternative transport modes.

The method integrates a literature review, and a quantitative online survey with mobility planning professionals. Neighbourhoods were categorised based on size and location using a pragmatic threshold of one hundred housing units, a criterion derived from expert consultations and insights into financing practices. This categorization provided a framework to compare urban and suburban contexts, revealing that restrictive measures, particularly parking management and traffic-calming, are highly effective in dense urban areas, whereas suburban settings require additional service-based incentives to compensate for lower density and higher car dependency.

This research contributes to a deeper understanding of how targeted mobility measures can reduce car dependency. It points out the importance of adapting strategies to specific neighbourhood contexts and integrating individual measures into comprehensive urban mobility plans. Finally, it contributes to the discourse on sustainable urban development by offering a schematic assessment approach for policymakers and urban planners aiming to achieve reasonable and environmentally friendly urban mobility systems.



**Keywords:** Mobility Instruments, Sustainable Mobility Transition, Integrated Neighbourhood Planning, Car Dependency, Avoid-Shift-Improve Framework

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# 1. Introduction

Germany’s mobility sector is undergoing a substantial transformation driven by the need to address increasing urban challenges such as traffic congestion, air pollution, and land-use conflicts as well as energy transition goals, and digitalization trends that demand integrated approaches to transportation planning. This transition also focusses on reducing the reliance on private vehicles by promoting sustainable alternatives, including enhanced public transportation, vehicle electrification, and strategies to encourage behavioural change in mobility (BMWI 8/6/2024; Bundesregierung 8/6/2024).

These efforts align with Germany's goal of reducing greenhouse gas emissions by 65% by 2030 and the European Union's broader objective of achieving climate neutrality by 2050. However, the German transport sector remains the only sector where emissions have risen since 1990, with road transport accounting for over 70% of total transport emissions, requiring a 90% reduction in transport emissions by 2050. (EUCO 2024, p. 3; European Parliament 4/6/2022, p. 7)

However, achieving these ambitious targets requires addressing deeply entrenched historical dependencies that continue to shape mobility patterns. As early as the 1960s, critics highlighted the negative effects of urban growth and car-centric planning, warning that increasing automobile dominance would diminish urban quality of life. Concepts such as "bedroom communities" and "cultural impoverishment" emerged, emphasizing how the spatial structure of cities became subordinated to cars, prioritizing efficiency over human-centred urban design. These critiques called for a shift towards urban environments designed around social interactions, walkability, and mixed-use spaces, a discourse that remains highly relevant in contemporary debates on sustainable urban planning. (Gehl & Svarre, 2013, p.2)

Furthermore, historical decision-making structures in urban planning were predominantly shaped by male-dominated perspectives, sidelining feminist and social critiques that emphasized alternative mobility needs, accessibility, and inclusivity (Kern 2021).

Despite these early critiques, Germany embraced a car-centric vision of modern life, which profoundly influenced its urban policies. By the post-war era, the automobile became synonymous with prosperity, supported by widespread societal and political consensus that cars are integral to a modern, successful life. For decades, the "car-friendly city" ideal shaped urban infrastructure, prioritizing automobile accessibility and establishing long-term dependencies on private vehicles. (Berding and Bukow 2020, p. 183)

These historical path dependencies continue to shape mobility transitions today, as policy shifts towards sustainable transport solutions must cope with structural and behavioural challenges embedded in urban and transport systems (Selzer 2022b). The persistence of car dependency can be observed in the steady increase of private cars in Germany, rising from 42 million in 2010 to nearly 49 million in 2024, reflecting the ongoing challenge of reversing car-centric mobility trends despite policy efforts to promote sustainable alternatives (KBA 2010, p. 47, 2024).

At the neighbourhood level, these challenges manifest through the dominance of cars in public spaces, displacing cyclists sometimes onto pavements and obstructing bike lanes with parked vehicles. This spatial dynamic reduces the safety and attractiveness of alternative transport modes, reinforcing car dependency rather than facilitating a modal shift. This highlights the need for a paradigm shift that addresses residents' daily realities. Given that neighbourhoods

form the immediate environment where daily mobility decisions are made, their spatial structure, location, and design are critical in shaping the accessibility of alternative transport options and the extent to which private car use remains the status quo. (Bauer et al., 2022, p. 28; Grafe, 2020, p. 65).

However, the fragmented policy situation further complicates mobility planning. Many mobility measures are not aligned with overarching transportation goals, reducing their effectiveness. For example, national policies such as commuter tax allowances, diesel subsidies, and company car privileges continue to incentivize car use, contradicting sustainable mobility efforts (Rammert 2019, p. 85). Addressing these contradictions requires precisely targeted and effective strategies that integrate environmental sustainability with social inclusivity. However, without clear, transparent, and enforceable policy framework, private and civil society actors often prioritize these individual interests over collective needs, further complicating the transition to sustainable mobility (Weber et al. 2022; Grafe 2020, p. 64).

The successful implementation of Germany's sustainable mobility transition relies on the contributions of diverse stakeholders, including research institutions dedicated to advancing sustainable mobility strategies. Among these, the Institute of Transport Research at the German Aerospace Centre (DLR) plays a significant role in supporting this transition. Specifically, the DLR project "Connected Mobility for Liveable Places" is developing a planning tool to assist in the design and implementation of neighbourhood-level mobility concepts (DLR 2023). This research benefited from the guidance of the DLR project, which provided expert insights on neighbourhood mobility and reinforced the importance of neighbourhood-focused approaches in advancing Germany's mobility and climate transition.

## Mobility Concepts

This research focuses on mobility concepts in urban neighbourhoods, which are central to Germany's mobility transition. Regardless of their frequent use in research and policy discussions, there is no universal definition of "mobility concepts," adding complexity to their operationalization and implementation. These concepts aim to reduce reliance on private cars by embedding alternative mobility options in context of housing and urban design. By influencing everyday mobility within neighbourhoods, these strategies promote environments where accessibility is no longer dependent on private vehicles but is supported by sustainable, mobility integrated into everyday spaces. By facilitating short and frequent trips through available alternatives, often starting and ending at home, these concepts not only encourage a shift in travel behaviour but also promote equitable access to mobility for all, gradually reshaping how residents engage with their surroundings. (Münsch and Lell 2024, pp. 25–26; Rammert 2019, p. 83; Selzer 2022a, p. 25)

Ideally, mobility concepts are accompanied by planning processes that incorporate principles of functional diversity, ensuring that housing, work, health care services, and recreational spaces are spatially integrated. This alignment strengthens the effectiveness of mobility measures by reducing the necessity of long-distance travel and supporting compact neighbourhoods where daily needs can be met within short distances. (Fischer and Sommer 2022, p. 1; Pietron et al. 2021, p. 51)

While mobility concepts present an opportunity to address car dependency, their effectiveness in practice remains uncertain. Experts and planners continue to debate whether these strategies can substantially reduce private car ownership and use or whether structural and

behavioural factors will limit their impact. For example, municipal parking regulations, which are used to discourage car ownership in new developments, cannot be employed to existing neighbourhoods unless. Heterogeneous ownership structures in inner-city areas, limited public space, and entrenched mobility habits make the introduction of alternative transport measures more challenging for transformative planning. (SenMV Bremen 2020)
Moreover, while advancements in alternative propulsion systems, such as electric vehicles, can play a valuable role in the transition, they should not be viewed as the sole solution. Instead, they must be integrated into a broader framework that prioritises a shift from car dependency toward sustainable alternatives like active mobility, shared mobility, and improved public transportation, as well as reduced dependencies through diversified land-use patterns/functionalities of urban space. Focusing exclusively on technical developments risks overlooking the fundamental need for a holistic mobility transition that addresses environmental, spatial, and social challenges comprehensively (United Nations 2016, p. 10). Achieving sustainable mobility requires a collaborative approach that aligns public policy with innovative mobility concepts. (Selzer 2022b; Pietron et al. 2021, p. 44; Münsch and Lell 2024, pp. 25–26; Rammert 2019, p. 83; Selzer 2022a, p. 25)

## 1.1 Research Objectives

Given the up-to-date limited predictability of success of mobility concepts towards sustainable planning objectives in neighbourhoods, this thesis addresses the effectiveness of mobility measures and integrated mobility concepts for four characterized neighbourhoods based on the experiences of experts from municipalities, independent planning offices and mobility research. Particularly, the research analyses the Impact of mobility measures across four neighbourhood types and analyse the combination of mobility measures for their potential to reduce parking space and shift car use towards public transport. Based on the following research questions this thesis examines various neighbourhood typologies categorised by size and location, to identify strategies and interdependencies in different urban contexts:

- How effective is the application of mobility instruments in context to the entity of neighbourhoods in order to contribute the achievement of sustainable objectives of the national mobility transition in Germany?
- How do the characteristics size and location of neighbourhoods influence the outcome of mobility measures?

### Content of Research

The following Chapter 2 delves into the theoretical foundation of mobility concepts and instruments, integrated approaches to mobility and transport research, and their historical development. Best practices, such as the Lincoln-Siedlung neighbourhood, are introduced with their respective tools, challenges, and limitations of mobility concepts. Chapter 3 outlines the methodology of the research, detailing the literature review, interview and survey methodologies, and the categorization and statistical analysis of the survey data. The findings of the survey are presented in Chapter 4, focusing on the effectiveness of mobility measures for

reducing private car dependency, promoting sustainable mobility, aligned with the ASI approach. Chapter 5 includes a comparative analysis of the measures' impact, contextualized within current challenges by experts' responses. The research is concluded in Chapter 6 and gives a broader outlook on the implications for future mobility transition and research.

# 2. Theoretical Background on Mobility and Transport at Neighbourhood Level

Today, both "mobility" and "transport" are often used interchangeably in political and academic discourses of Germany, leading to misunderstandings on both, the theoretical and practical levels. However, clarifying the analytical difference between these two concepts is important for mobility planning and the development of targeted transport interventions at the neighbourhood level and therefore as well in this research. Understanding how mobility choices shape transport demand is essential for designing strategies that promote sustainable mobility while reducing unnecessary transport movements.
In general, mobility is defined by the "flexibility between different, often equivalent choices" providing the basis for our daily interactions and opportunities such as work or social participation (Gatzert et al. 2023, p. 5). This flexibility is not only determined by the availability of transport modes but also by spatial planning, infrastructure quality, and socio-economic factors that influence the individual ability to move. Mobility therefore facilitates social, cultural, and economic exchange processes, which are central for our coexistence (Rammert 2019, p. 84). Subsequently, "transport" refers to the physical manifestation of these individual choices as well as goods, and data. As such, mobility and transport together support personal development and contribute to the functionality and efficiency of society (Gatzert et al. 2023, p. 6). Mobility dictates which transport movements occur and determines the means used to facilitate these movements. As a measurable consequence of mobility behaviour and transport infrastructure, "traffic" reflects the aggregated effects of individual choices and spatial conditions "Traffic" refers specifically to the flow, volume, and regulation of vehicles within transport networks. It represents a measurable phenomenon influenced by road capacity, congestion levels, and modal distribution. While mobility considers the individual's ability to move, and transport includes the systems that enable movement, traffic focuses on the combined movement patterns that emerge when multiple mobility choices interact within the same transport infrastructure. (Jarass 2012, pp. 28–29; Schwedes and Rammert 2020, p. 19)

Rammert (2024, p. 7) provides a useful illustration with three scenarios in which a person wants to have dinner. The first option involves driving to a restaurant, the second involves ordering pasta for home delivery, and the third involves cooking the dish at home. Each choice has different implications in terms of transport generation, with varying levels of direct and indirect impact on movement and transport needs. This example demonstrates that mobility serves as a subjective lens through which transport is generated. Measuring mobility therefore raises questions about limitations, as there exists a set of potential mobility choices on one hand and physical actions on the other. Both aspects can be quantified through behavioural patterns or measurable categories. Traffic jams and slowdowns exemplify measurable transport

phenomena that can be influenced by targeted planning interventions. However, equating high mobility with heavy traffic is a common misconception, even among experts. Effective mobility planning seeks to fulfil needs without necessarily increasing traffic, which is a guiding principle in exploring the impact of neighbourhood-level mobility concepts on both mobility and transport (Rammert 2019, p. 84).

### Field of Research: Neighbourhoods

Neighbourhoods significantly influence the design and implementation of mobility planning, as over 80% of trips in Germany start and end at home. Therefore, decisions about transport modes are often made in a housing context, emphasizing the importance and interdependencies of neighbourhoods and mobility patterns. (Bauer et al. 2022a, p. 28).

Neighbourhoods differ significantly in their characteristics, shaped by a range of parameters such as location, density, land-use, size, infrastructure or accessibility, resulting in unique mobility challenges and opportunities. For example, each person's perception of their neighbourhood varies, unless it is bounded by clear markers like rivers or major roads, from their personal circumstances, such as age or time availability. For instance, a retired person who enjoys leisure walks may view their neighbourhood differently compared to a schoolchild which focuses on school facilities and playgrounds (Berding and Bukow 2020, p. 81; Brand and Koucky 2021; Berding and Bukow 2020, p. 25; Busch-Geertsema 2018, p. 22).

Neighbourhoods can be seen a scale of urban society, functioning as the smallest shared social and spatial unit, providing familiar spaces for residents to build connections and navigate daily routines, raising trust and connection through repetitive, lived experiences. Walking, for example is the basic, repetitive mode of mobility. In major cities like Berlin or Hamburg, nearly one-third of trips are made on foot, emphasizing neighbourhoods as primary places for daily mobility. Thus, they play a central role in influencing resident’s immediate mobility choices and behaviours, making it an ideal place for implementing and testing mobility concepts for sustainable urban transitions. (Berding and Bukow 2020, p. 187)

In summary, mobility refers to the broader ability to move; transport involves the systems and methods used to move goods and people; and not traffic refers specifically to vehicle flow and congestion patterns.

## 2.1 From Traditional to Integrated Approach in Mobility

Traditional transport research has often relied on positivist, analytical-empirical methods, which emphasize measurable outcomes like efficiency and capacity, and modal-share. This approach has proven its value for infrastructure development, policies, and urban planning; however, it also faces criticism for overseeing human and social dimensions of mobility. It includes the historical prioritization of motorised transport during the 20th-century boom of car ownership, the denial of cultural and behavioural aspects, and the dominance of engineering and economic disciplines in shaping its research agendas. This has led to a narrow focus on technical and organizational solutions, often excluding individual experiences and alternative perspectives. (Wilde and Klinger 2017, p. 9)

While the primary focus of this work assesses regulatory and planning instruments, it is important to acknowledge that broader social theories offer alternative perspectives on car dependency. In this context, modern mobility is not merely a matter of regulatory or

technological improvement but also reflects a deep-rooted cultural and social regression. In context of the challenges of mobility transition can be understood through the lens of critical theory, such as the “Frankfurter Schule.” According to this perspective, modern society, while advancing in many ways, also reinforces limiting traditional practices. In the context of urban mobility, the dominance of private cars, despite efforts to promote alternatives, can be read as a sign of this contradiction. (Hindrichs 2017, pp. 61–64)

Although significant efforts are being made to encourage sustainable transport alternatives, such as public transit, cycling, and walking, the entrenched preference for private car use remains dominant. This persistence is not merely a technical or regulatory issue, it also reveals deep-rooted cultural and economic values that have long associated car ownership with personal freedom and success. Although there is an investment in policies and infrastructure to support sustainable mobility, the familiar and appealing image of the automobile continues to shape people’s choices. Recognizing these underlying social and cultural factors is essential, as they can significantly hold back the adoption of alternative transportation modes. Although this research does not explore social theory, recognizing these contradictions provides a critical context for understanding why certain sustainable mobility measures encounter resistance and why an integrated approach to the mobility transition must address both infrastructural challenges and entrenched social practices. (Groth 2019, p. 24)

Subsequently, beyond the inconsistent use of the terms "mobility" and "transport" across disciplines, the divide between traditional transport research and mobility studies has historically been shaped by analytical and academic-political motivations. While these two fields overlap in many aspects, disciplinary boundaries persist, with conferences, funding structures, and isolated career paths within disciplines, reinforcing segmentation rather than interdisciplinary collaboration. This division poses a risk to the broader integration and innovation needed to tackle the aforementioned complex mobility challenges (Wilde and Klinger 2017, p. 9; Busch-Geertsema 2018, p. 46). However, in many practical applications, a convergence between technical and social approaches is increasingly visible. Engineering disciplines are now more frequently incorporating lived experiences into planning strategies. This balance between quantitative data-driven methods and contextual socio-spatial analysis has become particularly relevant in neighbourhood-level mobility research (Rammert 2019, p. 85). While measuring indicators such as private car ownership provides valuable statistical insights, addressing social dimensions, such as accessibility, community acceptance, and behavioural incentives, is critical for shaping effective and sustainable transport solutions.

## 2.2 Integrated mobility planning on Neighbourhood level

The challenge of designing climate resilient neighbourhoods which can adapt int the future is a complex challenge that include besides the mobility transition other national sustainability objectives. It acknowledges that traditional transport development requires the understanding that urban development and mobility planning are deeply interconnected, shaped by numerous stakeholders, regulatory frameworks, and conflicting objectives. To address these complexities effectively, an integrated planning approach is required, one that combines diverse perspectives and operates across multiple dimensions. At neighbourhood level, integrated planning provides an important basis for coordinating mobility measures with locally specific objectives.

Rammert and Schwedes base integrated planning in regard of synchronising mobility, transport and infrastructure (traffic in this research) on four central dimensions (Schwedes and Rammert 2020, pp. 21–23):

Normative integration refers to the formulation of goals and guiding principles that balance social and ecological considerations with technological and economic requirements. At the neighbourhood level, this means that measures such as car-sharing or mobility stations must be embedded in a comprehensive strategy to ensure coherence and long-term effectiveness.
Political integration focuses on collaboration between different stakeholders and governance levels, including local authorities, housing associations, and mobility service providers. Effective mobility planning requires coordinated decision-making, ensuring that measures are adapted to local conditions and can be successfully implemented through intersectoral cooperation.
Spatial integration plays a significant role, as neighbourhoods can never be viewed in isolation. Measures such as the creation of car-free zones or the relocation of stationary traffic to neighbourhood garages must be spatially aligned the surrounding space in order to avoid conflicts, make use of synergies and allocate resources efficiently for infrastructure development.
Disciplinary Integration: Disciplinary integration highlights the need to coordinate different fields, such as urban planning, environmental governance, and social policy, to develop holistic mobility strategies. The transport sector in Germany has struggled to meet national climate targets, partly due to sectoral fragmentation. Integrated planning ensures that mobility strategies are developed with cross-sectoral awareness, preventing unintended consequences for other policy areas. However, implementing such an approach remains challenging due to the institutional separation of bureaucratic ministries in Germany, which often leads to isolated decision-making processes. (Rammert 2019, p. 84; Oliver Schwedes et al. 2018, p. 1)

## 2.3 The Avoid-Shift-Improve approach in Neighbourhoods

Although integrated planning provides the conceptual basis for neighbourhood mobility planning, the practical implementation of such strategies requires a framework that can systematically structure mobility measures. The Avoid-Shift-Improve (ASI) approach, presented in the following section, provides this function by presenting different intervention levels and facilitating the effective allocation of measures within urban and suburban contexts.
The early 1990s marked a turning point in urban and transport policy, as the increasing reliance on private motorized transport led to escalating environmental and spatial challenges that could no longer be mitigated only through infrastructure expansion. Today's planning approaches for achieving a sustainable mobility transition include the Avoid-Shift-Improve (ASI) framework, which serves as a comprehensive approach to address the technical, social, environmental, and policy-related complexities of mobility systems. This paradigm shift, integrating the sustainability framework, aims to optimize mobility systems in neighbourhoods while minimizing environmental impact through the three following interconnected strategies (Ringenson and Kramers 2022, pp. 218–219; 2016, p. 39) :

**Avoid:** The Avoid-Dimension aims to minimise unnecessary travel and reduce car dependency by creating spatial and regulatory conditions that eliminate the need for certain trips. In neighbourhood planning, this involves strategies such as reducing parking availability, summarising parking space, and implementing traffic-calming measures to discourage car use. Key strategies involve the promotion of compact, multimodal urban communities, both of which serve to reduce travel distances or eliminate the necessity for specific trips.

**Shift:** Encouraging a transition from less sustainable modes to more environmentally friendly options like walking, cycling, or public transport is central to this dimension. This is achieved by providing infrastructure and services that facilitate access to these modes, including mobility stations, bike-sharing, cargo bike-sharing, and mobility flat rates. These measures improve accessibility and enhance the attractiveness of alternative transport options by increasing their availability, convenience, and affordability. Policies such as prioritisation of public transport, and improved pedestrian and cycling infrastructure support modal shifts by making sustainable mobility more competitive with private car use. While the ASI framework includes the idea of maintaining besides the Shift- Dimension to avoid a deterioration of sustainable transport shares, this research focuses solely on the Shift-Dimension to actively reduce private car dependency rather than preserve existing transport shares.

**Improve:** This approach emphasizes increasing the efficiency and environmental performance of transport systems. This includes vehicle electrification, alternative fuels, intelligent transport systems, and improvements in public transport services. At the neighbourhood level, measures such as bike garages, improved transport hubs, and digital integration of shared mobility services contribute to more efficient transport networks. Improve measures aim to reduce emissions, optimise space use, and enhance transport system reliability, complementing Avoid and Shift strategies by increasing the sustainability of all transport modes. These aspects are less relevant to neighbourhood-level planning and therefore, indirectly addressed in the scope of neighbourhood planning (Figure1 ↓).

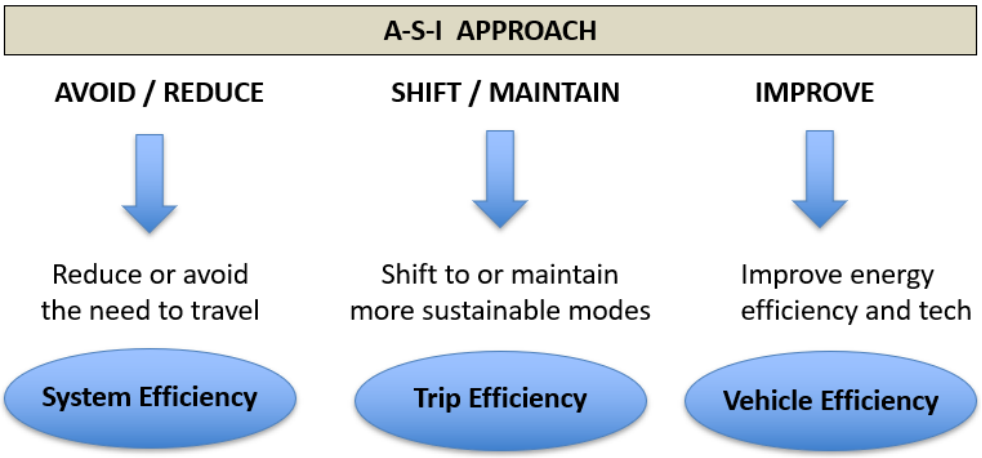



*Figure 1: Three dimensions of the ASI- Concept (own illustration based on UN 2016, p. 39)*

### Operationalisation of ASI-Dimension

While ASI provides a conceptual framework, its effectiveness relies on its operationalization in both urban planning and transport policy. It is not only a descriptive model that explains the complexity of mobility in a schematic way, but also a schematic tool for policymakers to balance mobility choices. The framework helps identify points of leverage where interventions, such as pricing mechanisms, spatial planning policies, participation, and infrastructure investments, can encourage sustainable mobility patterns. (Ringenson and Kramers 2022, p. 219)
To systematically analyse how mobility measures contribute to sustainable mobility transitions, the ASI framework was integrated into the design, structure, and evaluation of the survey. Aligning the survey with ASI offers a logical frame to filter respective mobility measures as well as planning objectives, while maintaining a holistic yet complexity radiating approach. The survey development and its foundational operationalisation process were created within this framework, ensuring a systematic and transferable methodology for assessing mobility measures. The classification of the instruments and measures will be further addresses in the following parts of this chapter as well as the subsequent interpretation of their contextualised impact in chapter 4.

## 2.4 Integrated Mobility Concepts and Instruments for Neighbourhoods

### The Role of Integrated Mobility Concepts

Latest trends in mobility planning on neighbourhood-level draw urban development towards objectives of guiding principles like the 15-minute city or the compact city, emphasizing local accessibility and active mobility. The focus is not limited to streets but includes the entire neighbourhood structure, integrating functional spaces such as local service areas, green areas, and other shared public spaces to promote seamless mobility within short distances. Aligning with these principles' mobility concepts aim to reduce car ownership while influencing neighbourhoods travel behaviour. These projects can include shared mobility hubs, reduced parking quotas, and improved infrastructure for walking and cycling (Appel et al. 2020, p. 182). The term "mobility concept" however lacks a universal definition and is used differently by various stakeholders depending on their priorities. However, in general it can be described as a "system of action guidelines aimed at influencing mobility demand to meet predefined transport objectives" (Becker et al. 2019, p. 71).

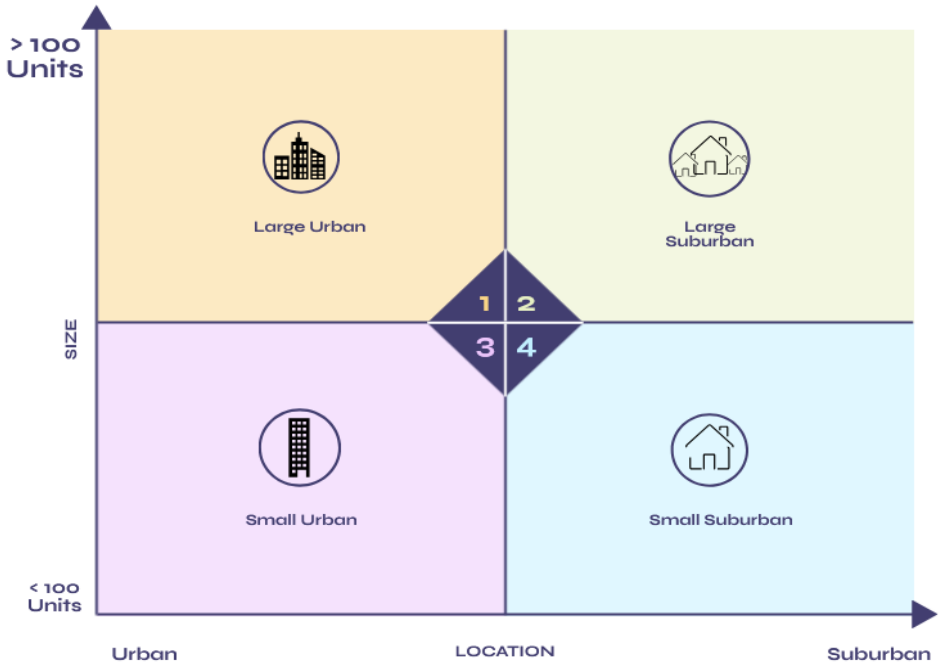
These guidelines are often designed to shape mobility in ways that align with specific sustainability, efficiency, or accessibility goals. In the absence of a standardized framework, mobility concepts are often context-specific, combined by suitable instruments for the respective neighbourhood or project. The creation of a mobility concept is not merely a static planning exercise but rather an iterative and long-term process. However, one of the greatest challenges has been to actually realise the mobility concepts comprehensively and not just individual elements. In the planning phase, development reports, road design and mobility concepts are often planned independently of each other due to the different expertise required

but are often not sufficiently coordinated causing disruptions in the transition from planning phase to the realisation and subsequent operation. Typically, the development phase spans one and a half to two years, sometimes even longer, depending on the complexity of the project, the stakeholders involved, and the scale of interventions. (Blees and Gertz, p. 854; Becker et al. 2019, p. 239)

### Operational Parameters: Size and Location

The decision to focus on size and location as key parameters originates from their ability to be measured, providing a reliable basis for analysing mobility measures. These parameters directly influence the feasibility and implementation of mobility measures and offer a certain structure for the research. In this research **size** refers to the number of housing units interdependent with the spatial extent of a neighbourhood its density (Figure 2 ↓) and **location** which is linked to further aspects such as the accessibility/ distance of infrastructure for example public transport but also daily facilities, and workplaces. Therefore, both parameters are framing and limiting the characteristics of environment for assessing the effects of the mobility measures yet including the further interdependent factors.(Blees and Gertz, p. 852)

Figure 2: Neighbourhood Parameters (Own Illustration and Content)




- 1: Inner-city, over 100 housing units
- 2: Suburban, over 100 housing units
- 3: Inner-city, under 100 housing units
- 4: Suburban, under 100 housing units

Additional parameters and indicators including land-use mix, accessibility, and the differentiation between new and existing developments, are relevant to detailed planning

processes. However, these could not be analysed separately in this framework due to the limitations of this survey, nonetheless the pioneer role of new development projects with mobility concepts builds an important basis for some of the mentioned cases studies in this research work. According to a study by the Federal Institute for Research on Building, Urban Affairs, and Spatial Development, over three hundred urban neighbourhoods were built in Germany after 1990, each accommodating at least five hundred housing units or 1,000 residents (BBSR, 2024, p. 17; Jarass, 2018, p. 24). These developments offer an opportunity to assess mobility concepts, as they are planned from the outset with integrated transport strategies. Unlike historically car-centric neighbourhoods, new developments allow for parking regulations, shared mobility infrastructure, and multimodal transport hubs to be implemented without major retrofitting challenges. However, their success does not guarantee seamless transferability to the majority of existing urban neighbourhoods which has to adapt to these conditions.
Following on from the previously mentioned parameters; Land-use mix, while relevant to mobility behaviour, is difficult to measure within the thesis level of generalisation and can produce overly complex or polarized results. Accessibility, though critical, is highly subjective and already indirectly reflected in the location parameter. Also, the distinction between new and existing developments in this research was considered as not significantly for the insights of the research question, as size and location mask the effect of different planning processes by development type.

Urban planning objectives such as decentralization and re-urbanisation, which are enabling residents to live, work, and socialize without relying on private vehicles align with the reinforcement of these spatial units. Addressing the interplay between housing, mobility, and socio-spatial dynamics is therefore essential in urban development, while providing fair access to resources like housing, energy, and mobility. Policies that prioritize socio-spatial equity as part of the regulatory framework can enhance inclusion and connectivity, addressing economic barriers and support social cohesion in neighbourhoods. (Grafe 2020, p. 44)
Today, mobility concepts act as strategic, yet informal frameworks that municipalities or developers adopt to guide the planning and implementation of mobility measures and traffic/-transport infrastructure in certain places of a city for its entire extent (Fuchs, p. 15; Frehn et al. 2021; Oehlert 2019, p. 9).

### Mobility Instruments

Mobility instruments as the operational core of mobility concepts, translate central planning objectives into concrete, implementable actions. They serve as essential tools to address challenges by targeting specific challenges such as traffic congestion, parking and infrastructure limitations. In densely populated areas for instance, these instruments can be relevant for reallocating areas usually reserved for car parking now for shared- or public spaces (Derer, 2023, p. 20). In new housing developments these principles have the chance to be included from the beginning of planning. Some municipalities reduce the obligation for parking space in new developments already if it is subsidized by a mobility concept. Today, there is empirical evidence which indicates for example that neighbourhoods, implementing mobility concepts require significantly less transport -related space estimated at approximately one-third compared to those without such frameworks. (SenMV Bremen 2020; Bauer et al. 2022a, p. 36)

Their successful implementation relies heavily on effective coordination and combination, clear regulatory basis, and integration across different administrative levels. While structural and procedural measures are often prioritized in urban planning, demand-oriented and action-driven approaches remain underrepresented in practice (Oehlert 2019, p. 69).
The following sections will explore key instruments of this research within mobility concepts, highlighting their roles, mechanisms, and practical applications in urban neighbourhoods demonstrated in various renown case studies within Germany, mainly from the cities Darmstadt, Köln and Freiburg. In the fourth chapter, the specific combination of the instruments will be further discussed and embedded into the context of different neighbourhoods.

### 2.4.1 Parking Management

Parking management represents a key instrument within urban mobility concepts, addressing the spatial and infrastructural challenges posed by stationary vehicles. By increasing parking costs and reducing the convenience of private vehicle use, these measures are designed to avoid unnecessary travel, discouraging short, unproductive trips, and to shift travel behaviour toward more efficient, alternative modes of transport. However, the role of parking management extends beyond mere spatial reallocation. It serves as a demand-side control mechanism, influencing travel behaviour by reducing the convenience and increasing the cost of car ownership. Strategies such as pricing, access restrictions, and relocation of parking spaces to peripheral areas are frequently employed to reduce car dependency and prioritize alternative transport modes. (Münsch and Lell 2024)
While these measures have demonstrated effectiveness in various urban contexts, their success is closely tied to local regulatory frameworks, spatial planning policies, and levels of public acceptance. In Germany, building regulations establish planning guidelines and obligations, such as the obligation to develop parking space for new housing developments (*Stellplatzpflicht*). This regulation dictates the provision of a minimum number of parking spaces for new residential and commercial developments. Officially municipalities have the authority to adjust or suspend these requirements when mobility concepts are presented as part of planning applications. This flexibility allows to experiment with parking solutions, reducing reliance on private vehicles and reallocating plots to alternative uses. (Becker et al. 2019, p. 18)
A notable example of this flexibility can be found in the Lincoln-Siedlung in the south of the city of Darmstadt (Figure 2). In this project the municipality leveraged its regulatory authority to facilitate a reduced parking quota of 0.65 spaces per residential unit based on a mobility concept which is concentrated on multimodality. A share of 0.15 of these parking spaces are reserved for mobility-impaired residents and car-sharing, while the remaining 0.5 spaces per unit are located on the neighbourhood’s margin. The development process began in the year 2008 and is intended to set new standards for Darmstadt's new build neighbourhoods, whereas the mobility concepts has been implemented in the project since 2016. The success story of the Lincoln- Siedlung was recognized with the German Transport Award in 2018.(Klein et al. 2021)
The primary objective was to ensure comprehensive mobility solutions for residents, expanding the environmentally friendly transport network based on the "push & pull" principle, while

implementing targeted measures to regulate motor vehicle traffic in alignment with broader urban mobility goals.

Figure 3: Lincoln- Siedlung Darmstadt (OpenStreetMap)

In the context of mobility concepts, the coordination of measures can be classified into two primary functions: incentivizing sustainable mobility choices or imposing restrictions on car use (Samaan and Wagener 2023, p. 3). Pull measures, which incentivize behavioural shifts, include infrastructure enhancements such as dedicated bike lanes or expanded public transportation

services, alongside awareness campaigns promoting the use of environmentally friendly alternatives like (cargo) bike-sharing or mobility flat rates. In contrast, push measures, such as parking management or speed restrictions, impose constraints on certain modes of transport. These measures encourage a shift towards alternative mobility options by making car ownership and private vehicle use less attractive. (Selzer 2022a, p. 24; Marquart et al. 2021, pp. 9–10)

The city of Bremen demonstrates the importance of standardized legal frameworks to ensure coherence and effectiveness of parking management strategies on a city/ state level, but which are ultimately also applied at neighbourhood level. The local law on car parking spaces requires developers to either provide parking and bicycle storage spaces or pay a financial compensation. Since its 2013 amendment, §9 of the law allows for these compensation funds to be invested in mobility concepts, aiming to provide new residents, such as those moving into a new development, with improved access to sustainable transportation options (SenMV Bremen 2020, p. 11). Moreover, research highlights the critical need to align public street parking regulations with private property management to prevent regulatory loopholes that could undermine overall effectiveness. For instance, if free public street parking remains available alongside restricted private parking facilities, the intended demand-control effects of parking policies may be significantly weakened. (Oostendorp et al. 2020, p. 183)

The development of vehicles powered by electricity or alternative fuels is often discussed as a tempting solution to the consequences caused by the $CO^2$-emissions of private motorised transport (Kampker and Heimes 2024, pp. 39–40). The advantage of this technology is that it would require insignificant change to the transport system and the related mobility behaviour, common in the global north[1] which has developed over the century. However, the general occurrence of high land consumption by private car ownership is frequently overlooked as, regardless of the energy demand required for fuelling e- or hydrogen vehicles, parked vehicles occupy 8% to 16% of total public space. In cities where space is limited, it is therefore a problem at a large scale (Münsch and Lell 2024). This consumption of scarce urban space often limits opportunities for alternative uses, such as green areas, pedestrian zones, or cycling infrastructure.

Most case studies reveal the limitations of standalone parking measures, as in dense urban environments, pricing single adjustments and parking restrictions prove to be insufficient to address established patterns of car dependency. Complementary measures, including traffic-calming strategies and improved public transportation services, are normally necessary to achieve long-term behavioural change (Samaan and Wagener 2023, p. 3). In practice, regulatory flexibility, as seen in the Lincoln-Siedlung case, offers valuable insights into balancing parking management with broader mobility goals. When municipalities are allowed to adapt parking requirements in alignment with well-designed mobility concepts, the potential to reclaim urban space, reduce car dependency, and support active mobility patterns becomes increasingly achievable. Furthermore, the implementation of parking management strategies often encounters resistance from residents and local stakeholders. Restrictions on parking availability, increased costs, and perceived inconvenience can provoke strong opposition, threatening the

[1] The terms ‘Global South’ and ‘Global North’ are increasingly replacing terms such as developing countries, emerging countries and the previously frequently used term ‘Third World’ (Source: BMZ Lexikon 2025))

success of these measures. One essential component of public parking management is the monitoring of stationary traffic as parking offences must be consistently dealt with; local authorities have an important duty here. Research underscores the importance of transparent communication and active public engagement to address these concerns. Clearly communicating the broader benefits of parking management, such as improved urban quality, reduced noise pollution, and enhanced accessibility, can play an important role in promoting public acceptance and support. (Selzer 2022b; Keiper and Schönharting 2022)

### 2.4.2 Neighbourhood Garages

The design and organization of parking spaces in neighbourhoods have undergone significant changes in recent years, driven by the need to balance sustainability, spatial efficiency, and long-term adaptability. Conventional approaches, such as underground parking garages located directly beneath residential buildings, often come with considerable construction and maintenance costs while unintentionally encouraging car dependency due to their proximity to living spaces. In response to these challenges, neighbourhood garages offer a more centralised and flexible parking model accommodating changing mobility needs. The decoupling of parking spaces from housing purchases or rentals and the transparent pricing of parking spots based on their true costs ensure both economic and environmental sustainability. However, separating parking from housing alone does not necessarily lead to reduced car ownership unless it is embedded within a comprehensive mobility concept. While being already implemented in newly developed neighbourhoods and housing developments, their application in existing urban neighbourhoods remains relatively uncommon. (Oostendorp et al. 2020, p. 184; Blees and Gertz, p. 853)
In the Lincoln-Siedlung in Darmstadt most parking spaces are located in centralised garages on the periphery of the neighbourhood within a walking distance of three hundred meters from the residential units. This spatial separation minimizes the convenience of car use for short trips while still maintaining adequate accessibility for essential journeys. Additionally, 0.15 parking spaces per unit are reserved for mobility-impaired residents and shared car use schemes, ensuring inclusivity and flexibility. Through the decoupling from housing costs, residents without vehicles are not burdened by preventable expenses. (Bauer et al. 2022b, p. 37)

A similar approach can be observed in the Vauban district in Freiburg, widely regarded as a pioneering example of car free/ reduced neighbourhoods, which was planned and constructed between 1994 and 2009 (Figure 4).


Figure 4: Neighbourhood Vauban in Freiburg (OSM)

The former French military base provides today 2.000 housing units with around 5.500 residents which can reach the city centre of Freiburg within 10 to 15 min by tram (Öko-Institut e.V 2003). Besides the objectives of sustainable energy concepts and supporting sustainable lifestyles, one of the ideas in Vauban was to create a neighbourhood with short distances and mixed-use spaces, which can be found in the concept of compact city as well (Marquart et al. 2021, pp. 12–13). For this reason, parking spaces are spatially and financially separated from residential areas, preventing the integration of private parking facilities into individual housing plots. Instead, two centralised neighbourhood garages provide many parking spaces. Residents who own a car are required to purchase a parking space at actual construction costs, without cross-subsidization from housing prices. For all households, the commitment of a car-free lifestyle, is ensured through a membership in the "Verein für autofreies Wohnen e.V.," which involves a declaration of a car-free housing model. The spatial separation of parking spaces not only reduces traffic within neighbourhoods but also creates opportunities for safe pedestrian zones and community spaces. As a result, Vauban has achieved significantly lower car ownership rates, with an average of 0.6 cars per residential unit across the district. (Mahzouni 2018, p. 1479)

In Stellwerk 60 in Cologne, a similar strategy has been implemented to create one of the first partially car-free neighbourhoods in the city. The residential units for 1,550 residents were built on a 4-ha area, located 3km from the Cologne city centre, between 2005 and 2013. With a parking quota of only 0.2 spaces per residential unit, the concepts of Stellwerk 60 centralizes parking facilities in a neighbourhood garage, positioned at the district's periphery. Residents are legally bound to a car-free commitment, registered directly in property leases to ensure long-term compliance. The neighbourhood garage includes eighty parking places for residents and forty places for visitors, reaching a balance between accessibility and minimal car presence within the neighbourhood. Beyond parking provision, Stellwerk 60 features well-developed cycling infrastructure, two car-sharing stations, and convenient public transportation access via S-Bahn, bus, and tram connections. (Stellwerk 60 2021; Blechschmidt 2016, pp. 59–61)
The experiences from Lincoln-Siedlung, Vauban, and Stellwerk 60 demonstrate that neighbourhood garages are not merely technical solutions to parking problems but also catalysts for broader urban transformation. When combined with integrated mobility services, active transportation infrastructure, and community-oriented design, they can significantly contribute to reducing car dependency and improving spatial efficiency.

### 2.4.3 Traffic-calming measures

Traffic-calming measures prioritize the accessibility for pedestrian and cyclist while limiting the speed and flow of motorized transport, contributing to quality of living in the neighbourhood. Common strategies include speed limits, pedestrian zones, restricted vehicle access, and spatial redesigns that make streets safer and more inviting. The legal framework for implementing traffic-calming measures in Germany is primarily defined by the Federal Road Transport Act (StVG). While municipalities often request for greater flexibility in applying lower speed limits or limiting parking, they already have access to a variety of effective instruments for traffic-calming. For example, traffic-calmed commercial zones are particularly well-suited for busy streets with high pedestrian traffic and a significant social function. Similarly, traffic-calmed residential areas often feature walking speed limits and uniform street-level surfaces, promoting a more balanced use of street space. Area-wide 30 km/h zones, along with bicycle streets and newly introduced bicycle zones, offer additional tools for improving traffic flow and safety in residential neighbourhoods (Bauer et al. 2022b, p. 16). In neighbourhoods with high pedestrian densities or historic city centres, more restrictive measures, such as electronically folding poles, are used to regulate access. While these systems can be cost-intensive, they are effective in reducing transit-traffic and preventing unauthorized parking. More invasive measures such as cul-de-sacs or loop streets can help additionally to keep non-local motorized transport out of the neighbourhood.

The temporary neighbourhood project of 2019/2020 in Hamburg Ottensen describes itself as an exemplary case of how traffic-calming strategies can transform public spaces and shift mobility behaviour towards more sustainable patterns (Bezirksamt Altona 2019). The eight hundred meters spanning project assessed innovative solutions which show that especially mobility in existing dense urban quarters do not have to depend on cars, and that public space can serve purposes far beyond simply accommodating parked vehicles. To avoid unnecessary

motorised traffic and shift mobility towards non-motorized modes, the project implemented access regulations. Private and commercial delivery traffic was limited to off-peak hours (23:00 to 11:00), and entry points to the project area were marked with bold, coloured floor patterns and featured specially designed parklets. These parklets not only served as physical barriers but also provided seating, greenery, and informational displays that reinforced the new traffic-calmed environment. The evaluation of "Ottensen macht Platz" revealed that approximately 70% of residents experienced improved neighbourhood atmosphere, public space quality, and enhanced safety for pedestrians and cyclists. Although local business responses were mixed—with some concerns over delivery and commercial access—the majority supported the continuation of the project, suggesting modifications such as further street redesigns. (Stein and Bauer, pp. 20–27)

### Traffic-Calming Measures: The Bergmannkiez project in Berlin

The Bergmannkiez project in Berlin offers another recent example of how comprehensive traffic-calming measures can reshape urban neighbourhoods. This initiative transformed the central Bergmannstreet into a largely car-free zone over a three-year period, serving as a model for future neighbourhood design. Key measures include a gradual implementation of a ban of transit traffic and a stepwise reduction of speed limits across the district, the installation of a protected two-way cycle lane, the deployment of green elements, the implementation of an enforced 10 km/h speed limit, one-way traffic regulations in specific sections, and the creation of designated delivery and pedestrian crossing areas (Figure 5↓). Citizen participation has been a core component of the project as extensive public consultations and participatory processes have guided the planning and implementation, ensuring that the measures meet local needs and enhance the overall quality of the public space (Bezirksamt Friedrichshain-Kreuzberg 5/16/2019). The Bergmannkiez project illustrates a strategic approach to avoid excessive through-traffic and shift mobility toward active modes, reinforcing how comprehensive, phased interventions can gradually transform urban mobility. The project's systematic evaluation, using traffic volume, speed data, and even air quality measurements conducted by external agencies, underscores the importance of evidence-based planning in achieving lasting traffic-calming outcomes. (DUH 2021, pp. 16–22)

Figure 5: Bergmannstreet in Berlin. (*Photos by the author*)

## Challenges and Complementary Strategies

While traffic-calming measures offer substantial benefits, their success depends on several factors. For instance, technical enforcement tools such as electronic speed monitoring and

signage must be paired with physical infrastructure changes to ensure compliance. In many cases, speed limits and signage alone are insufficient, as drivers may ignore or bypass these controls. Hence, many municipalities are combining regulatory measures with physical interventions, like raised crossings and redesigned intersections, to create environments where traffic naturally slows down.
Furthermore, public acceptance is a critical factor. Transparent communication and active stakeholder engagement are necessary to avoid resistance and to shift public perceptions towards appreciating the broader benefits of these measures—such as enhanced social interaction, reduced noise pollution, and improved urban liveability.
In summary, traffic-calming measures serve as a multifaceted approach that not only avoid inefficient and unsafe travel behaviours but also shift the focus towards more sustainable and community-friendly modes of transportation.

### 2.4.4 Car-Sharing

Car-sharing services offering flexible, demand-driven alternatives to private car ownership by providing access to shared vehicles. One of the primary objectives of car-sharing is to avoid privately owned vehicles that are most of the time not used but still occupy valuable spaces for parking. Car-sharing contributes significantly to sustainability goals by reducing the need for private car ownership and optimizing the use of existing vehicles. Geldmacher estimates that each shared vehicle can replace up to ten private cars, thereby reducing the environmental footprint associated with vehicle production and maintenance. Furthermore, shared vehicles tend to be used more efficiently, with higher utilization rates than privately owned cars, which often remain unused for most of the day. By promoting shared mobility, car-sharing can support urban planning objectives aimed at reducing traffic congestion, lowering greenhouse gas emissions, and reclaiming urban space for alternative uses such as green areas and pedestrian zones. (Geldmacher, pp. 73–74)
However, its success largely depends on how well it integrates into local mobility infrastructure, including public transport networks, cycling facilities, and neighbourhood-specific mobility hubs (Bauer et al. 2022b, p. 29).

Station-based systems: These systems require users to pick up and drop off vehicles at designated locations, making them more suited to planned, longer trips. Station-based car-sharing has proven effective in residential mobility concepts due to its reliable availability and predictable access points. In fact, such systems have been associated with a significant reduction in annual car mileage—from an average of 11,300 km to 2,500 km after adoption. (Krietemeyer 1997, pp. 14–20)

Free-floating systems: These allow for more spontaneous use, as users can pick up and drop off vehicles anywhere within a defined operational area. However, they are often criticized for merely substituting short walking or public transport trips rather than effectively reducing car dependency. (Geldmacher, pp. 13–15)

In practice, station-based car-sharing aligns more closely with long-term sustainable mobility goals within neighbourhoods. For example, in Vauban, Freiburg, dedicated car-sharing stations are strategically located in central, visible spots within the neighbourhood. Their proximity to housing areas offers a practical advantage over private parking facilities, while their visible placement continuously reminds residents of the service and encourages its use. (Öko-Institut e.V 2003)
A further key factor in the implementation of car-sharing is the nature of its carrier or provider. In the Lincoln-Siedlung both systems are offered but are predominantly operated by municipally affiliated organizations that focus on sustainable, locally integrated mobility solutions. These public carriers work closely with local public transport, or neighbourhood mobility hubs, ensuring that their services are adapted to reduce private car use and align with broader urban sustainability goals. On the other hand, there are also privately managed or cooperative models that often operate on an international scale. These private providers typically emphasize operational efficiency, market penetration, and flexibility, which can lead to different usage profiles. While private models may offer attractive spontaneous mobility options, they sometimes do not integrate as seamlessly with local transit systems and urban planning objectives, making them less effective at achieving long-term reductions in car dependency. (Samaan and Wagener 2023, pp. 68–69)
However, evaluations of a survey focusing on the local law on car parking spaces in Bremen revealed that challenges such as uncertainties regarding vehicle availability, unclear pricing structures, and limited access in lower-income neighbourhoods can hinder broader adoption of car-sharing. These findings underscore that while car-sharing can effectively avoid the spatial drawbacks of private car photership and shift travel behaviour toward more sustainable models, its success depends on addressing socio-economic and operational challenges. (Daubitz 2011, p. 189)
Overall, car-sharing exemplifies a dual ASI approach in neighbourhoods by avoiding the inefficient use of urban space and shifting residents toward more sustainable and integrated mobility alternatives. The choice of carrier, public versus private, plays a crucial role in determining the service's alignment with local mobility goals and its long-term impact on reducing car dependency. (SenMV Bremen 2020)

### 2.4.5 Bike-Sharing and Cargo Bike-Sharing

Bike-sharing and cargo bike-sharing systems play distinct but complementary roles within urban mobility concepts. Therefore bike-sharing systems are primarily designed to facilitate short daily trips, such as commuting to nearby public transport stations, or completing first- and last-mile journeys, which makes them especially effective in bridging gaps in public transport networks, offering flexibility for spontaneous travel and creating seamless multimodal connections. Compared to free-floating bike-sharing, station-based systems offer predictable availability and structured access points, making them more reliable in context of housing, just as in the application case of car-sharing systems on neighbourhood level. The station-based model is as well particularly suited for cargo bikes, as they are often returned quickly, to ensure availability for other users. Cargo bike-sharing in contrast is interesting for transport and logistical requirements that regular bicycles cannot offer. Due to high investment cost, affordable options

for shared cargo bikes increase possibility to do weekly grocery shopping, transporting bulky goods, or managing family trips with equipment or children without the demand for large personal investment. Cargo bikes are typically used for short journeys, while electric cargo bikes offer increased range and efficiency for slightly longer routes. (Becker et al. 2019, pp. 159–160).

In the Lincoln-Siedlung in Darmstadt, bike-sharing services are integrated into the neighbourhood's mobility concept through a combination of bike-sharing and cargo bike-sharing options. The Call a Bike system by Deutsche Bahn operates two bike-sharing stations in the neighbourhood, providing residents with easy access. Additionally, a free subsidized cargo bike, is available for community use. To complement these services, the former local company *Sigo* offered two electric cargo bikes at a dedicated rental station (Wissenschaftsstadt Darmstadt 2020b). Also in the mobility concept in Stellwerk 60 in Cologne incentive the use of alternative; offering cargo bikes, hand carts, and bicycle trailers to borrow from the neighbourhood mobility station to support independence from cars (Bauer et al. 2022b, pp. 35–36).
However, in the evaluation process of neighbourhoods in Berlin like the Waterkant, the respective survey results reveal a lower perceived usefulness of bike-sharing services. While cargo bikes are occasionally used for errands or family outings, almost 60 % of respondents reported limited benefits from the service. This outcome reflects the high prevalence of private bicycle ownership in the area, where shared systems primarily serve niche purposes. Emphasizing this uncertainty, a study on the effectiveness of the local mobility construction law of the city of Bremen (*Mobilitäts-Bau-Ortsgesetz Bremen*) identified; the availability of bikes at sharing-stations, and high fees as main barriers for realisation, as discouraging factors for regular use among lower-income households, as well as high private bike ownership rates, which often reduce the perceived necessity of shared systems. (Bauer et al. 2022b, p. 29; Becker et al. 2019, p. 162)

### 2.4.6 Bike Garages

Bike garages play a significant role in promoting cycling as a reliable mode of transport, particularly once initial incentives have been established to encourage a shift toward increased bicycle use. An important factor influencing the decision to use a bicycle for daily transport, beyond leisure activities, is accessibility at home. The location and convenience of bicycle storage directly impact whether cycling becomes a habitual transport choice. If a bicycle must be regularly transported from a basement to the street, the additional effort, or resistance to travelling, discourages use, whereas if the bike is available at the front door, similar to a private car, cycling is more likely to be integrated into everyday routines (infas et al. 2019, p. 48). These accessibility challenges are particularly pronounced in urbanised areas, where housing conditions, especially in larger apartment blocks, often limit the availability of convenient and secure bicycle parking. Empirical evidence reinforces these concerns.(Blees and Gertz, p. 853)
Findings from the Viennese project "Meine Fahrradgarage" revealed that approximately 25% of respondents identified inadequate bicycle parking conditions as a barrier to regular bike use (Bauer et al. 2022b, p. 28). Similarly, the MiD (Mobility in Germany) study from 2017[2] reported

[2] MiD 2023 not yet published

that 84% of bicycle owners store their bikes inside their homes, while only 11% park them outside (infas et al. 2019, p. 48).
Subsequently, implementing bike garages comes with its own challenges, including issues related to costs, site selection, and user acceptance. Despite these challenges, bike garages are an important instrument to lay the foundations for a sustainable mobility transition in the neighbourhood. They help avoid the over-dimensioning of parking spaces and support the shift from reliance on private cars to more integrated, multimodal mobility solutions, thus contributing to a complete mobility concept. However, quality standards regarding their location, design, and technical features are frequently overlooked, even though existing state building regulations and municipal parking statutes require a minimum number of bicycle parking spaces. Many developers and planners prioritize quantity over important factors like proximity to building entrances, ease of access, and theft protection as retrofitting inadequate installations can lead to substantial costs. (Becker et al. 2019, p. 162; infraVelo 2024)

### 2.4.7 Mobility Stations

Mobility stations are infrastructurally implemented measures within urban mobility concepts positioned at single, accessible central intersections concepts positioned at single, accessible central interconnections, designed to connect multiple transport services, such as shared cars, bicycles, and public transport. Originally derived from the mobility centres, introduced in Germany during the 1990s, which focused on ticketing services for multiple transport systems, modern mobility stations have developed into integrated places with both infrastructural physical and digital appliances. The spatial integration of mobility stations is highly dependent on local urban design strategies and neighbourhood-level mobility concepts. While some are positioned at major public transport hubs, to facilitate regional connectivity, others are integrated into neighbourhoods, using space on the ground floor of neighbourhood garages/mixed-use buildings, or just centrally located unoccupied space. Additional services, that further expand their functionality include, for instants parcel lockers or basic bicycle repair stations, further expand their functionality (Becker et al. 2019, pp. 297–298).
The implementation of mobility stations can be showcased with the service provider Jelbi in Berlin to reflect on local regulatory and spatial planning conditions. The Jelbi mobility stations, developed in partnership with municipal housing companies[3] are located primarily on private grounds, ensuring control over infrastructure and service quality. From a digital perspective, mobility stations are closely aligned with the concept of Mobility as a Service (MaaS) of the smart mobility discourse, aimed at integrating multiple transport modes into a single, accessible platform. It describes the future transport sector as cooperative, networked ecosystem of seamlessly combinable transport services that meet customer needs. Today, however, it is characterised by a service model that can influence travel behaviour. Its core feature is that it integrates different modes of transportation for point-to-point travel and offers common payment options for the services, and that planning and payment are done via an online platform. (van Dijck et al. 2018, p. 2; Ringenson and Kramers 2022, p. 218).
Berlin's Jelbi app serves as an all-in-one mobility platform, consolidating Berlin's diverse transport services into a user-friendly application. Through real-time traffic data, the app

[3] https://www.jelbi.de/lindenhof/

enables users to compare different transport options based on duration, cost, and convenience, allowing them to select the most suitable mode of transport for their journey. The Jelbi App therefore represent the digital backbone of the city's mobility stations, supporting their effectiveness and transparency. (Jelbi 2023)
The effectiveness of mobility stations in neighbourhoods relies nonetheless on their integration into a broader urban mobility network. A single station cannot transition mobility substantially if it operates in isolation. Instead, a cohesive network of interconnected stations is required, ensuring consistent service coverage across urban spaces, assuming sufficient demand to avoid any oversupply (Pietron et al. 2021, p. 44). Behavioural patterns challenge the adoption of mobility stations as well; although once residents express willingness to reduce private car ownership, they often wait for specific triggers, such as major repair costs or the expiration of vehicle inspections, before making significant changes or before one get rid of their car. This aversion emphasizes the need for mobility stations to be paired with restrictive push measures, such as parking management strategies, to create tangible incentives for behavioural shifts (Bauer et al. 2022a, p. 43).

### 2.4.8 Mobility Flat Rates

Mobility flat rates integrate multiple transport services into a single, cost-effective package and primarily serve to shift travel behaviour through an incentivation towards sustainable transport solutions. By bundling public transport tickets, car-sharing allowances, or bike-sharing memberships into one subscription, which is primarily effective when fixed as part of the tenancy agreement; these packages make alternative modes more attractive and accessible from the start of tenancy. However, the implementation of mobility flat rates depends on the regulatory framework and the financial structure of housing projects. In privately financed housing developments, mobility services can often be integrated into the rent at the point of initial leasing or renewal. In contrast, publicly subsidised, rent-controlled housing projects face stricter limitations due to regulated rent caps. (Becker et al. 2019, pp. 289–291)
The financial sustainability of mobility flat rates also varies by project size and implementation model. Smaller housing projects, for example, often require initial financial support agreements with mobility providers, including minimum revenue guarantees or temporary subsidies until usage levels stabilize. In contrast, larger-scale developments benefit from economies of scale, allowing more extensive mobility packages to be implemented at relatively lower costs per-unit. In most cases, the financial viability relies as well on the cost savings achieved through reduced parking infrastructure requirements, making them particularly interesting for projects prioritising car-free or car-reduced living spaces as well as new developments (Bauer et al. 2022a, p. 34).
Tenant tickets for public transport, where housing companies negotiate group discounts with transit operators to provide residents with affordable monthly or annual subscriptions such as the "Mobil-Flat" programme (SWA 2/2/2025) introduced by the Augsburg public utilities offers integrated mobility subscriptions which include public transport access, bike-sharing services, and car-sharing allowances. The higher-tier package provides 30 hours of car-sharing with unlimited kilometres, while the lower tier offers 15 hours with a 150 km cap. However, the launch coincided with the COVID-19 pandemic, which impacted user adoption rates and limited

the ability to draw definitive conclusions about the programme's long-term effectiveness. Another example comes from Nürnberg, where the housing company WBG introduced the mobility package “bewegt.wohnen.” This programme offers tenants a discounted public transport pass (10 € per month), paired with a minimum usage requirement for car-sharing services (12 uses per year). Such models demonstrate mobility flat rates could be integrate seamlessly within housing infrastructure of neighbourhoods (Becker et al. 2019, pp. 289–291).
As part of Bremen's parking space regulations (Stellplatzortsgesetz Bremen) it has been possible since 2013 to replace car parking spaces in new housing projects with mobility concept measures. Here, the advantage lies in the cost savings for the construction of underground car parks. A quantitative and qualitative study was conducted by team red Deutschland GmbH to investigate the impact of the mobility concepts already implemented on car ownership and car use as well as potential for improvement in the process and communication. The study revealed that including public transport passes in mobility packages not only substitute existing subscriptions but also significantly increase overall ticket availability and usage. Furthermore, public transport tickets were ranked as the most valued mobility measure among surveyed residents.
The financial sustainability of mobility flat rates depends on the size of included residential units; smaller housing developments may require initial support agreements, like minimum revenue guarantees or temporary subsidies, until usage stabilizes. In contrast, larger-scale ones benefit from the economies of scale and possible cost savings from reduced parking infrastructure requirements (Bauer et al. 2022a, p. 34). Digital platforms, such as Berlin’s Jelbi app, can also further enhance the shift by providing seamless, single-interface access to multimodal transport options, thereby simplifying booking, payment, and journey planning.

Nonetheless, such integrated mobility solutions are embedded in a broader, economically driven platform model that may carelessly reinforce social inequalities. The reliance on digital infrastructure and rental-linked subscriptions tends to favour technologically confident, privileged urban residents while excluding groups with limited digital access or lower incomes. (Bauriedl and Wiechers 2021, pp. 107–108)
This selective accessibility can result in what is sometimes called the "multimodal divide" (Groth 2019, p. 24) where the benefits of alternative mobility solutions are unevenly distributed.
Moreover, the market dominance of large platform providers raises concerns that profit and data monetization may override socially and environmentally driven mobility goals. Such providers risk sidelining public mobility solutions and ignoring local needs through standardized flat rates, while the data-driven nature of these platforms poses risks to digital privacy and public trust. Consequently, although mobility flat rates effectively shift residents toward multimodal transport, they do not inherently avoid car dependency or improve service quality without supportive regulation. In summary, while mobility flat rates are a powerful shift measure within the ASI framework, issues of social exclusivity, market concentration, standardization, and data privacy must be addressed through targeted regulation and inclusive design to achieve a just and sustainable urban mobility ecosystem. This critical reflection will not be further explored in this work, but it underscores the necessity of thoroughly considering every measure or instrument within a broader context. (Riemens et al. 2021; Sommer et al. 2024, p. 241)

# 3. Research Design and Methodology

To gain a comprehensive understanding of how mobility services and concepts function within neighbourhoods in Germany, this research first inherits literature research, then employs collection of data through interviews and a standardized expert online-survey and respectively puts the findings in context with an Avoid-Shift-Improve (ASI) framework. The following chapter outlines the process of this methodological approach, from the operationalization of theoretical concepts to survey design, data collection, and analysis.

The research methodology builds on a quantitative approach (Kothari 2004, p. 14; Jarass 2018, p. 47), using the Avoid-Shift-Improve (ASI) framework to integrate and structure the results of the survey. Aligning the survey with these three mentioned dimensions, the ASI framework offers a logical structure to operationalize mobility measures. Not only a methodological challenge; the effect measuring of mobility concepts as it is not possible using technical instruments, such as for determining global warming or the GDP. Nevertheless, gathering insights through previous interviews with experts considered this difficulty while developing the operationalisation of this research. By quantifying the impact of individual measures and their combinations, the survey highlights the interactions between various mobility tools and their effectiveness in achieving planning objectives. This approach serves as a foundational methodological tool to systematically evaluate the survey data, allowing the identification of patterns, frequencies, and relationships between mobility measures and their perceived effectiveness across neighbourhood types.

## 3.1 Literature Review

This literature review synthesizes key academic studies, policy reports, and case evaluations on a selection of urban mobility instruments, from parking management and traffic-calming measures to bike garages and mobility flat rates, using the Avoid-Shift-Improve (ASI) framework as the guiding conceptual lens. The review establishes a fundamental framework for understanding how these measures contribute to reducing private car dependency and promoting multimodal mobility while offering essential context for interpreting forthcoming expert survey data on the effectiveness of these instruments.

The selection of case studies was based on several criteria, including the recognition, age, and geographic context of the projects, as well as their planning approaches. Established concepts, such as Vauban, whose planning phase began in the 1990s, demonstrate long-term strategies, while more recent initiatives like Waterkant, despite being smaller and having fewer inhabitants than larger projects such as the Berlin Bergmannstreet traffic-calming initiative, share the common objective of aiming for a sustainable mobility transition in residential neighbourhoods. The key parameters such as such size or location also had to be considered: projects in urban centres (Ottensen in Hamburg) contrast with rather suburban examples (Lincoln-Siedlung), though both contribute to the principal goal of transforming neighbourhood mobility and respective planning objectives.

In the selected literature and case studies, a combination of push and pull measures is evident as the differential weighting and combination of these measures across neighbourhoods

illustrate that effectivity of mobility concepts require context-specific strategies that consider local needs, urban density, and existing infrastructure.
The examination of case studies proved to be labour-intensive, as numerous concepts are documented in informal planning reports and local guidelines, making them less accessible. This challenge reflects the absence of a general framework for mobility concepts and underscores the need for a more standardized approach to documenting and evaluating these initiatives.
Due to the broad scope of urban mobility instruments, this review focuses on the aspects most relevant to the ASI dimensions, emphasizing those measures that directly contribute to reducing private car dependency and promoting multimodal transport. For instance, while the Lincoln-Siedlung includes comprehensive parking management and mobility consultation, only the elements most significant to the defined categories of shift and avoid are discussed.
Although this research does not include additional survey rounds, it is important to note that the DLR Institute plans further expert survey rounds on the effectiveness of these mobility measures. These future surveys, conducted with diverse groups of experts, will expand on the initial findings and provide deeper insights into the nuanced performance of various urban mobility instruments.
Overall, this literature review not only maps the current state of research on sustainable mobility instruments but also critically examines their transferability and the contextual factors, such as project age, scale, location, and the interplay of push and pull measures, that influence their effectiveness. By accounting for these variations, the review lays the groundwork for a nuanced understanding of how these instruments function in practice, highlighting the need for a holistic and context-sensitive approach to urban mobility planning within the ASI framework.

## 3.2 Preliminary Interview

Due to the limited empirical data available on the impacts of mobility measures in neighbourhoods, exploratory interviews with mobility experts were conducted following the literature review. The primary aim of these interviews was to gain practical insights into the constraints and potential effectiveness of specific mobility measures, particularly regarding the persistence of car-centric mobility models and the challenges of implementing alternative approaches. (Kaiser 2014, p. 20; Bauer et al. 2022a, p. 35)
It is important to note that these interviews were not intended as a comprehensive qualitative study nor as a primary data source; rather, they served as a foundational research step to inform the development and operationalization of the subsequent questionnaire survey. The insights gained helped refine the survey questions by providing context-specific feedback on theoretical approaches and real-world challenges in urban mobility. Although no formal transcripts were generated and the interviews were not subjected to systematic qualitative analysis, the unstructured, hour-long conversations allowed interviewees to discuss their experiences freely, thereby reducing the risk of socially or scientifically desirable responses.
The exploratory nature of these interviews meant that the selection of participants was not systematic; rather, expert contacts were identified through existing networks and referrals from previously conducted interviews (Jarass 2018, pp. 48–49). This flexible approach, while not constituting a triangulation method within this research, provided valuable contextual

foundations for shaping the survey instrument. (Raab-Steiner and Benesch 2021, p. 47; Kaiser 2014, p. 42)

Derived from the literature review, the following guiding questions were used to focus the interviews:

- What is your professional and academic background?
- What goals do you pursue in your work?
- What are your biggest challenges?
- How do you measure the success of your work?
- What methods and tools do you use to make decisions?

In summary, while these preliminary interviews are not the primary data source of this study, they play a crucial role in informing the research design and enhancing the understanding of the complex factors involved in the implementation of mobility measures. The insights obtained underscore the necessity of a carefully considered approach to urban mobility planning and the development of effective, operational survey questions.

## 3.3 Survey Design and Structure

The empirical foundation of this research is built upon a structured expert survey designed to capture practical experiences of urban mobility planning stakeholders with mobility concepts, assessing the effectiveness and potential of mobility measures and combinations at the neighbourhood level. The survey, designed for experts, was conducted using a questionnaire-based approach, which facilitated the collection of standardized responses from experts all over Germany. The survey aims to examinate the role of private car ownership and-use in four neighbourhood settings.

### Question Development

The selection and development of the survey questions were guided by a two-step process. First, a comprehensive literature review and preliminary expert interviews were conducted to identify key mobility instruments and relevant contextual factors. The questionnaire was structured according to literature on:

- Background of Experts
- The effectiveness of selected mobility measures in influencing modal shift.
- The role of neighbourhood characteristics in shaping mobility patterns.
- The interaction between push and pull measures in promoting sustainable transport.
- The alignment of mobility measures with the Avoid-Shift-Improve (ASI) framework.
- The combination of measures implemented in practice.
- The influence of spatial factors, such as neighbourhood size and location.
- The role of policy and planning interventions in facilitating sustainable mobility transitions

This thematic focus was carefully developed prior to the finalization of the questionnaire, ensuring that the instrument systematically addresses both the isolated impact of individual

measures and the dynamic interactions between them. While the detailed content of the questions is reserved for the analysis (4) chapter, this focus provides a clear, logical progression, from background and context to detailed evaluations and combination strategies. To ensure clarity and comparability, the survey primarily employed structured questions with predefined response options, allowing for statistical analysis. However, some open-ended questions were included to capture qualitative insights and expert reasoning behind measure selection.

**Pre-Test and Distribution**

Participants for the Pre-test were selected based on their professional backgrounds and expertise in urban- and mobility planning on the one hand but some as well regarding their unfamiliarity with mobility concepts on the other hand, to assess the overall understanding and to ensure a range of perspectives. The feedback gathered during the pre-test was used to adjust question phrasing, response options, and the overall survey structure to ensure a logical flow and to avoid overwhelming participants. Closed-ended questions were restructured for efficiency, while optional open-ended questions at the end allow for additional insights aligning with the survey's focus and established empirical methods (Honer 1994, p. 626; Reinecke 2014, pp. 614–615). This iterative improvement process created the final survey, providing a user-friendly and methodologically coherent foundation.

### 3.3.1 Technical Implementation

The final survey, implemented thru the survey Web-Software *Lime-Survey*, was distributed mainly to planning institutions of municipalities, mobility consultancy firms and respective research institutions ensuring a diverse sample of expert opinions. The primary approach to access participants involved contacting established professional networks and respective organizations. Most participants were reached through a personal email invitation distributed through the exchange list of the NAKOMO-Conference of June 2024. Additionally, the research was supported by the Institute of Transport Research of German Aerospace Centre (DLR) as the research focus aligns with the project "Connected Mobility for Liveable Places", which is developing a planning tool to assist in the design and implementation of neighbourhood-level based mobility concepts (DLR 2023). The DLR therefore supported with an outreach for additional experts through the DEPOMM-network newsletter and the German Association of Geographers.

Furthermore, although this master's thesis does not incorporate additional rounds of expert interviews, the Institute of Transport Research at the German Aerospace Centre (DLR) plans further survey rounds with different expert groups to deepen the understanding of mobility measures' effectiveness. This future research will further validate and expand on the findings presented here.

Generally speaking, the response rate in an online survey can be seen as a form of self-selection by respondents, since it is often difficult to determine who participated and whether the provided information is accurate. The online survey offers significant advantages as it is cost-/ time effective requiring no personal interviewer as participants complete the questionnaires themselves. Further costs and time are saved on subsequent coding and data entry, as the data

is collected directly on a server and is immediately available to the researcher, thus avoiding errors from manual data entry. (Kallus 2016, p. 134)
The choice of this method was therefore influenced by its spatial flexibility and the ability to collect a high number of responses within a short period. Ultimately, out of 118 responses, a total of sixty-six complete expert responses were submitted within three weeks. However, due to variations in the selection process and the validity of responses, the number of valid three-measure combinations differs slightly across analysis blocks.

### Statistical Analysis

The questionnaire data was analysed using frequency queries and cross-tabulations, utilizing the statistical software SPSS and Excel. In the initial phase, frequency queries were conducted to provide an overview of the distribution of individual variables and to identify preliminary trends. To better categorize and interpret the data, relative frequencies were calculated and expressed as percentages, which were then visualized in diagrams. This process involved coding variables in SPSS and using cross-tabulations of the matrices. For example, if a respondent selected Measures 1, 2, and 3 for a specific neighbourhood, the corresponding variable for this combination was marked in the dataset. This iterative approach was systematically applied across all neighbourhood types, resulting in eighty-four potential measure combinations per neighbourhood type. SPSS was then used for statistical analysis to determine the frequency of each combination, thereby highlighting the sets of measures most frequently selected by respondents.

## 3.4 Methodological Limitation

The given length of this thesis framed the possibilities of the survey as well as the participants' attention of approximately 10 to 15 minutes. The complexity of the topic and various levels required a thorough but careful abstraction of parameters. The characteristics of neighbourhoods for example, had to remain limited to two parameters. Therefore, the approach of not describing the individual parameters too precisely was pursued here, to achieve indirect assumptions of the experts about the location and size, with the risk of a certain bias. Due to these practical and technical requirements within the complex field of mobility, the contextual variations across neighbourhoods and case studies lead to necessary repetitive acknowledgment of limitations within the course to provide coherence. For example, strategies for new developments which are included in planning from the start, may encounter incomparable challenges when applied to existing neighbourhoods, where constraints like pre-existing infrastructure or established travel behaviours might require adjustment of planning.
The gained data provides general trends and frequency distributions, with further examination of variations in relation to size and location in the analysis. To analyse frequencies of individual measures, combinations and positive correlations, new variables were created according to common rules of statistics (Bhattacherjee 2012, pp. 118–123). The simplicity of the chosen parameters provides a structured analysis of effects of mobility instruments on private car ownership, while the results maintain a high degree of transferability with the respective neighbourhood types. However, the integration of current case studies comes with limitations in regard of their transferability, as each of the cases reflects the distinctive characteristics of

their settings, such as geographical location, size, and socio-demographic conditions. Moreover, the objectives of the best practices reflect the different priorities of their developers and local politics and policies. Therefore, some may highlight environmental goals, such as reducing car dependency or promoting active mobility while others prioritize social cohesion, inclusivity, profitable efficiency or only marketing reasons (Kallus 2016, p. 31). On one side, these various approaches improve the overall understanding of mobility concepts but on the other side the inclusion of best practices results in limiting effects. Therefore, in the context of generalisation and abstraction of this work, the results do not claim to propose universally valid solutions but rather highlight transferable elements of interdependencies and its own approach, which are meant inform broader mobility planning frameworks and further research.
The results of this survey as well as the final questionnaire will be presented in Chapter 4, where the interdependencies of neighbourhood characteristics, planning objectives, and mobility measures will be examined in depth as well.

# 4. Analysis

Parallel to the operationalisation of four neighbourhood, the process selection for mobility measures began. Finally, the following selection of nine mobility instruments (Table 1↓) were developed on literature and preliminary interviews. The aim was to identify measures that effectively address mobility needs in both urban and suburban neighbourhoods while supporting the broader objectives of the mobility transition.

Respondents were asked to value the sensitivity and potential effect of these instruments on private car ownership within various neighbourhood settings in context of a specific goal. By quantifying the impact of individual measures and their combinations, the survey highlights the interactions between various mobility tools and their effectiveness in achieving planning objectives.

| Measure/Instrument | ASI Framework | Planning Objectives | Related Survey - Questions |
|---|---|---|---|
| Mobility flat rates | Shift, Improve | Reduce car dependency; promote public transport | C3, E1, E5 |
| Mobility stations/points | Shift, Improve | Encourage use of shared and sustainable transport modes | D1, E1, E5 |
| Car-sharing | Avoid, Shift | Reduce private car ownership; provide alternative transport options | A2, C4, D1, E1 |
| Cargo bike -sharing | Shift | Enhance non-motorized mobility options for goods transport | A2, E1, E5 |
| Bike-sharing | Shift | Promote active mobility and last-mile connectivity | C1, E1 |
| Bike garages | Shift, Improve | Improve bicycle use by providing secure parking | C1, E1 |
| Traffic-calming measures | Avoid | Reduce traffic speed and volume; enhance safety and walkability | C2, D1 |
| Parking management | Avoid | Reduce car ownership through reduced parking availability and higher fees | C4, D1, D5 |
| Neighbourhood garages | Avoid | Concentrate parked cars to free up public space for other uses | C2, D1 |

Table 1: Assessed Mobility Instruments and Measures

The survey[4] structure of thematic blocks (A–F) ensures that the questions systematically addresses both individual measures and their combined application. It moves from general

[4] Appendix

effectiveness (B1) to contextual evaluations (C1–C4) and finally explores interactions between instruments (D and E).

Each block builds on the previous one, allowing for a deeper understanding of how individual and combined measures operate across neighbourhood types. Challenges identified in Block F offer additional context for interpreting quantitative findings, linking the findings to implementation obstacles:

### Block A: Implementation and Expertise

Assess the respondents' professional experience and familiarity with the nine selected instruments. Questions focused on whether respondents had implemented, planned, or had no direct experience with each measure.

- A1: What type of institution/company do you work for?
- A2: Which mobility offers/measures from the following selection have you already implemented or are you planning to implement in residential neighbourhoods?

### Block B: General effectiveness towards sustainable mobility transition

Evaluates the perceived overall effectiveness of the nine selected instruments in advancing mobility transitions at the neighbourhood level.

- B1: How effective do you consider the respective measure of the following selection to be in general for **promoting sustainable mobility transition** in the residential environment?

### Block C: Effectiveness of individual measures in neighbourhood context

Assesses the perceived effectiveness of each mobility instrument in reducing car dependency. Respondents were asked to rate the effectiveness of the measures in the context of each neighbourhood type. The focus on these four instruments in Block C allows for an in-depth analysis of their individual effectiveness in reducing car dependency, while the broader set of instruments is considered in combination in later blocks. This approach balances the need for detailed insight with the practical constraints of survey length and respondent attention, eventually contributing to a more coherent and targeted evaluation of urban mobility measures.

- C1: How effective is the provision of **bicycle garages** in promoting the use of private bicycles more attractive in the respective neighbourhoods, regardless of the cycle path infrastructure?
- C2: How effective is the relocation and bundling of stationary car traffic in **neighbourhood garages** to create more space for pedestrians?
- C3: How effective is the offer of a **mobility flat rate** (incl. public transport ticket) in shifting private car use to public transport in the various neighbourhoods?
- C4: How effective are **parking management** measures (fewer parking spaces, higher charges) in reducing private car ownership in the respective neighbourhoods?

Block D: Measure combinations- Reducing stationary car traffic:
Identifies synergies between measures when applied together to reduce stationary car traffic. Respondents choose and rank combinations of measures, providing insight into strategies they consider most effective:

- D1: Which three measures would you choose to **reduce stationary car traffic** in small urban neighbourhoods?
- D2: "…" in **large urban** neighbourhoods
- D3: "…" in **small suburban** neighbourhoods
- D4: "…" in **large suburban** neighbourhoods

- D5 Optional question: Are there other measures not mentioned here that you consider particularly important in combination to reduce stationary car traffic in the neighbourhood?

Block E: Measure combinations- Shifting car use
Comparable to Block D, but focusing on shifting car use to walking, cycling, and public transport.

- E1 Which three measures would you choose to **promote a shift from car use to walking, cycling and public transport in the neighbourhoods?**
- E2 "…" in **large urban** neighbourhoods
- E3 "…" in **small suburban** neighbourhoods
- E4 "…" in **large suburban** neighbourhoods

- E5 Optional question: Are there other measures not mentioned here that you consider particularly important in combination to promote a shift from car to walking, cycling and public transport in the neighbourhoods?

Block F: Further Challenges of Implementation
Identifies Challenges of implementing mobility measures at the neighbourhood level. The open-ended question captures qualitative insights into financial, regulatory, and cultural obstacles.

- F1: What challenges do you currently see as crucial in the implementation of mobility measures at neighbourhood level?

After the outlined structure of Blocks A–F, the subsequent section begins with the examination of the key findings (A-E Block) in the same order to illustrate how various mobility instruments interact to reduce private car use and promote sustainable mobility.

## 4.1 Findings

This chapter presents the assessed effectivity of mobility measures and instruments within the aforementioned neighbourhoods in context of private car ownership/use, as well as their synergies observed through their combination. The answers consist of 118 responses participants, with sixty-six complete submissions, primarily from professionals in public administration (67 %), independent planning offices (9 %), and research institutions (9 %) visualized in Figure 6 below. The results provide a solid foundation for evaluating the applicability, effectiveness, and further challenges of mobility measures in urban and suburban neighbourhoods.

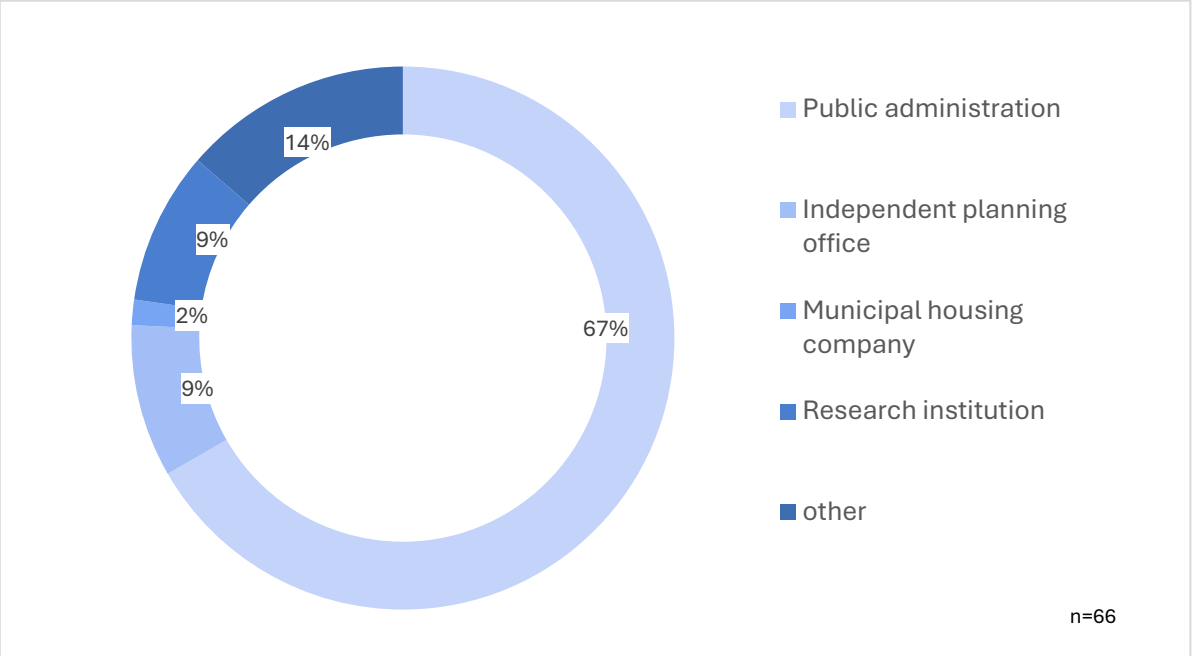



Figure 6: Professional background of participants[5]

While this analysis provides valuable insights, further limitations must be acknowledged as findings are shaped by the professional backgrounds of the respondents, and therefore potentially biases to their organisational roles and respective experiences affecting the generalisation of the results. By addressing the potential and challenges of these instruments across diverse contexts, the analysis contributes to a deeper understanding of strategies aimed at reducing car dependency and promoting sustainable mobility.

## 4.2 General Expertise

Experts were asked to indicate whether they had implemented, were currently planning or had no direct experience regarding the chosen mobility instruments. The results provide valuable insights into the practical familiarity of planners and stakeholders with urban mobility tools. Measures such as parking management and traffic-calming measures demonstrate the highest implementation rates, with 47 % of respondents reporting practical experience in these areas,

[5] Answer A1

reflecting the current focus of planning practice (Bauer et al. 2022a, p. 28). Similarly, mobility stations (45 %) and car-sharing (40 %) show high implementation rates (Figure 7↓).

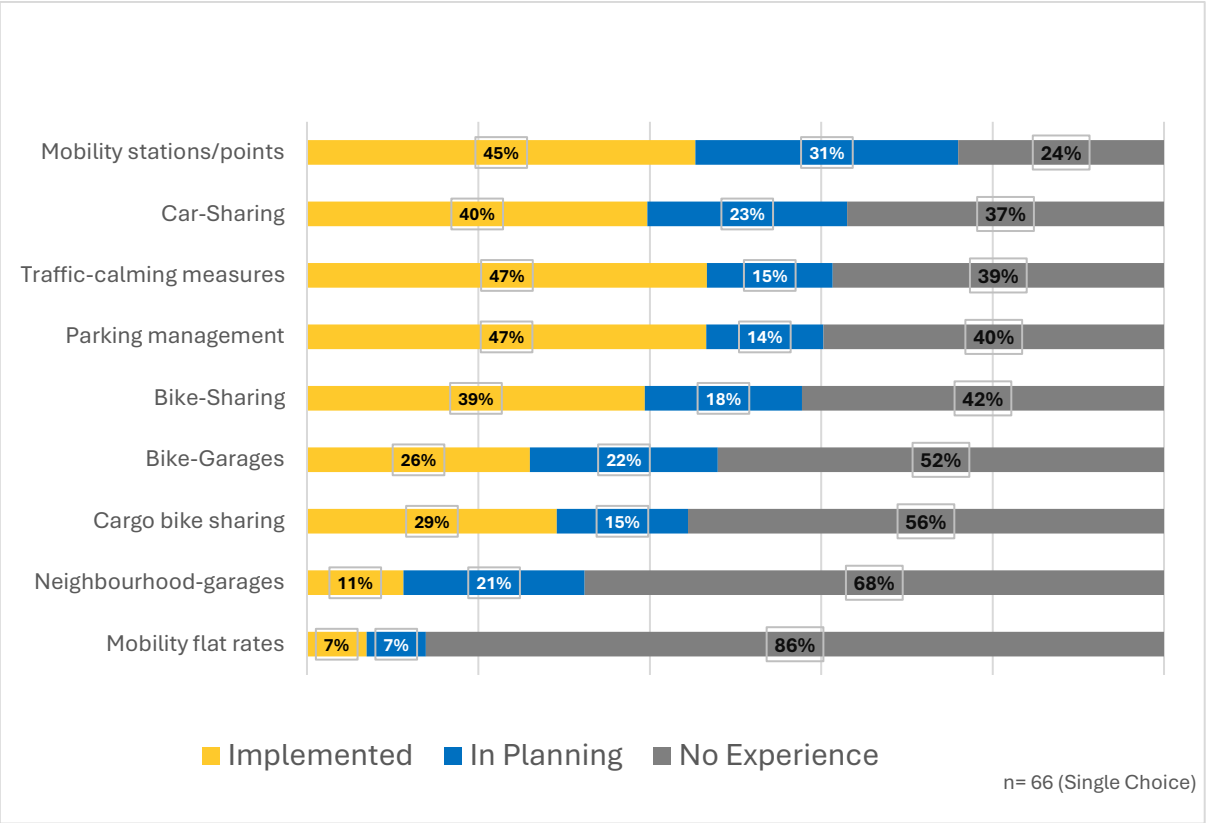



Figure 7: General Experience of Participants.[6]

In contrast, measures such as neighbourhood garages (11 %) and mobility flat rates (7 %) show significantly lower levels of practical implementation compared to other instruments. Even though they are often discussed within practical guidelines, their realization remains limited. Neighbourhood Garages, despite their potential to optimize urban space and reduce on-street parking pressure, require substantial initial investments, and must be carefully integrated into existing urban infrastructure. Similarly, mobility flat rates, designed to offer bundled access to various mobility services, face challenges related to regulatory requirements and financial feasibility, which appear to slow down their adoption.

In terms of the “In planning phase,” mobility stations (31 %) emerge as the most frequently planned measure, followed by neighbourhood garages (21 %) and bike garages (22 %). The relatively high planning activity around these measures suggests a focus on creating multimodal hubs and improving infrastructure for active mobility. Mobility stations are planned to serve as central nodes for integrating different transportation options, including public transit, bike-sharing, and car-sharing services. On the contrary, measures like cargo bike-sharing (15 %) and traffic-calming measures (15 %) appear less frequently in planning phases, indicating a more selective or localized approach to their future implementation.

When examining the "No direct Experience" category, significant differences between the instruments become evident. mobility flat ates (86 %) and neighbourhood garages (68 %) have

[6] Survey Answer A2

the highest percentage of respondents indicating no direct experience. This suggests that these measures are still relatively new in practice and face notable barriers to implementation, such as unclear regulatory conditions or high operational complexity. On the other hand, measures like bike-sharing (42 %) and car-sharing (37 %) show lower rates of inexperience, reflecting their broader adoption and familiarity across different urban contexts.

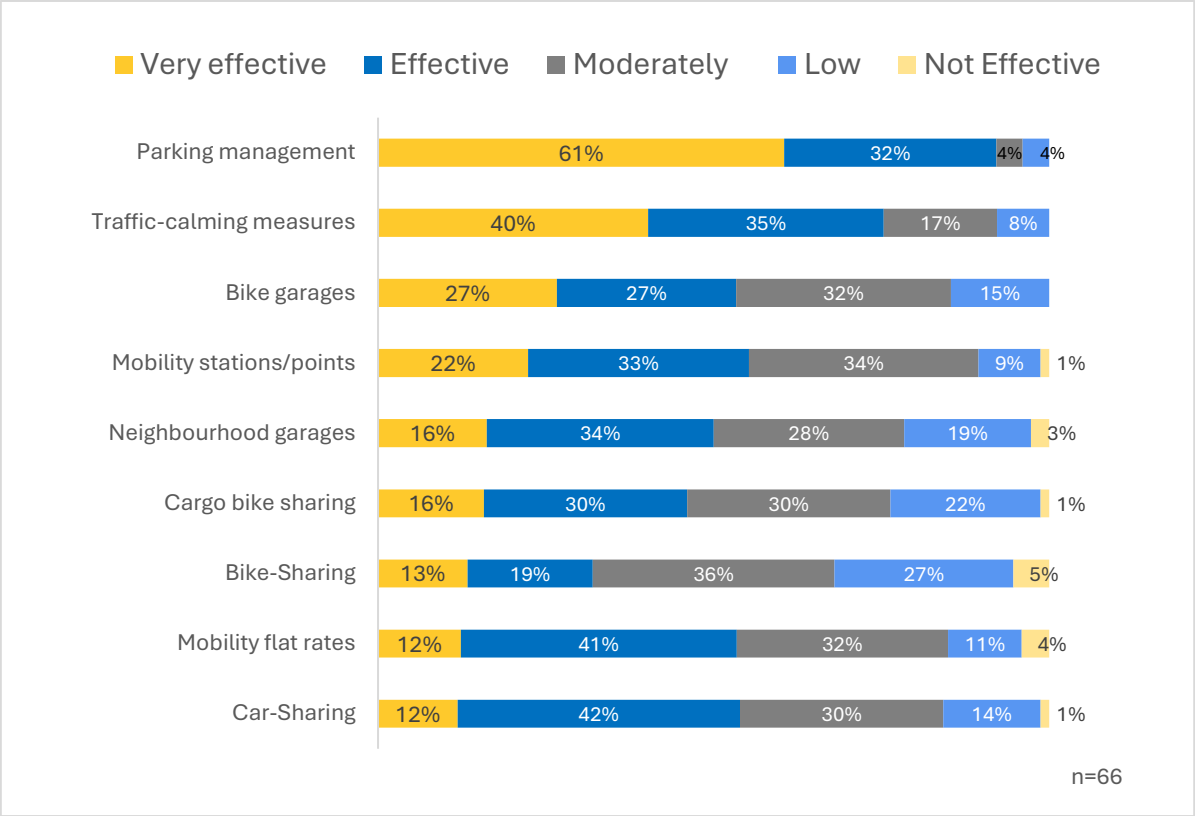



Figure 8: Assessment of General effectiveness towards sustainable mobility transition.[7]

The expert-assessment of the overall effectiveness of mobility measures towards **sustainable mobility transition** reveals a clear statement across the nine evaluated measures (Figure 8↑) and neighbourhoods' location and size. Clearly the experience of implementation and planning of these (Figure 7↑) does not correspond with the evaluation of their overall effectiveness, as experience with the respective measure does not lead to a higher valuation of effectiveness.
For example, although most of the participants have been implementing mobility stations, or are in the planning stage, their effectiveness however is only rated in third place. Likewise, the implementation of car-sharing among experts is very high by 40 %, but only 12 % rate its effectiveness as very good (Figure 8↑). The data on bike-sharing strengthen this assumption, as more than 50 % have already implemented or are planning to implement this measure. However, its effectiveness, like cargo bike-sharing is assessed very low in comparison, with 68% considering it as moderately effective to not at all effective. Finally, two specific measures are assessed as most effective (very effective and effective); Parking Management with 92 % and Traffic-Calming Measures with 75 % share a common characteristic: they primarily focus on

[7] Survey Answer B1

spatial reallocation and regulatory interventions rather than relying on behavioural change or technological integration. This prospective shows a preference among experts for measures that can create physical spatial and traffic-related improvements based on a restrictive approach.

## 4.3 Effectiveness of Individual Measures within ASI

Block C of the survey focuses on assessing the perceived effectiveness of four key mobility instruments in reducing car dependency across four neighbourhood types. The selection of these four instruments, bicycle garages, the relocation and bundling of stationary car traffic, mobility flat rates (including public transport tickets), and parking space management measures, was based on their frequent use in both the literature and case studies, as well as their direct relevance to the Avoid- and Shift-Dimensions of the ASI framework. Due to the limitations of this research, not all instruments could be surveyed in combination with specific planning objectives. It is important to note that the exclusion of the other five instruments in this block does not imply that they are unimportant. Rather, Block C is designed to provide a detailed evaluation of those instruments most closely aligned with achieving common planning objectives within Avoid and Shift goals. The remaining instruments are subsequently addressed in Blocks D and E, which explore measure combinations and their synergies, ensuring a comprehensive overall analysis of mobility strategies.

### 4.3.1 Parking Management

Parking management as a central measure in urban mobility planning, aims to reduce private car dependency and repurpose urban space for alternative uses. Its impact, viewed from the Avoid perspective of the ASI framework, reduce the attractivity of car use, as it can increase the distance and reduce the access to the car, making it less attractive for users.
In urban neighbourhoods, parking management is perceived as generally effective to reduce, with 80 % to 90 % of respondents rating it as either "very effective" or "effective" (Figure 9↓). In suburban neighbourhoods, however, the perceived effectiveness of parking management measures is not rated as very effective in the same way. Approximately 50 % of respondents in both small and large suburban neighbourhoods rated the measure as "effective" or "very effective," while the remaining responses reflected moderate to low levels of approval.

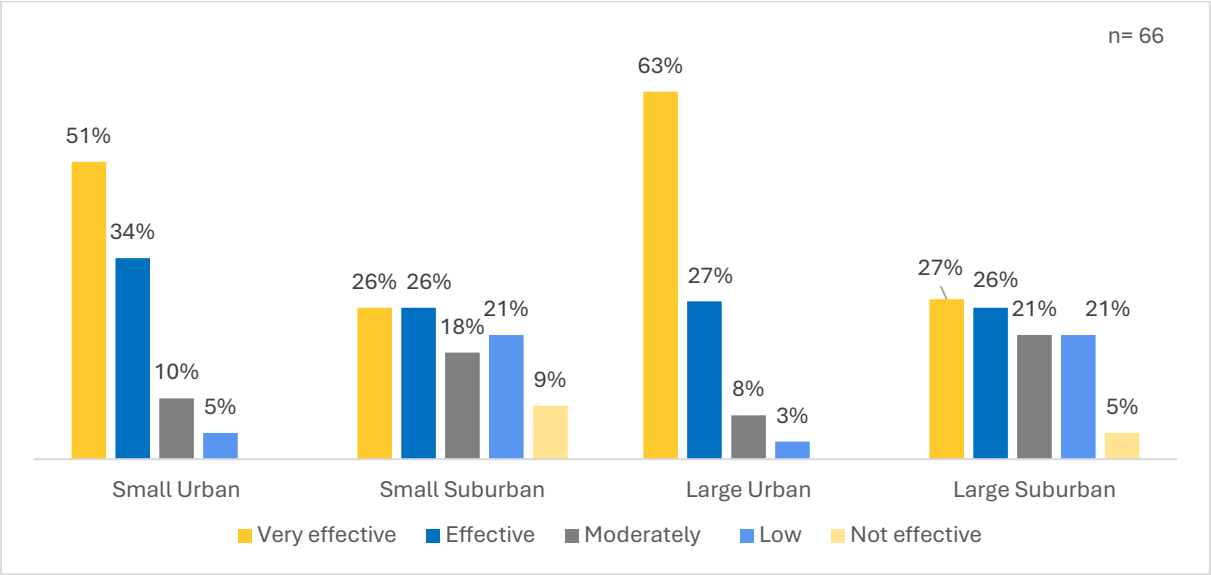



Figure 9: Effectivity of parking management on reducing private car ownership.[8]

## Geographical Disparities

These results indicate a strong connection between parking management and car ownership, even though in suburban neighbourhoods, the effectiveness of parking management is more constrained (Figure 9↑). This urban- suburban disparity can be attributed to differences in density and accessibility. Suburban neighbourhoods, characterised by lower population density and limited access to basic services, inhibit greater dependency on private cars. The location of a neighbourhood shapes not only the mobility needs of residents but also the feasibility and success of alternative transportation measures. The subsequent creation of these facilities and everyday services in the neighbourhood can promote more independence of cars, however the adaption relies heavily on the quality and expansion of the local transport system. (Blees and Gertz, p. 852)

Rammert (2023, p. 2) summarizes how mobility behaviour is closely linked to settlement structure conditions, although structural adjustments of these alone are insufficient to establish sustainable mobility. Differences in travel behaviour are also influenced by individual preferences, such as wealth levels, which can drive increased car use even without changes in travel distances (Bauer et al. 2022b, p. 47). This underlines the complex interplay between spatial conditions and personal choices in shaping mobility patterns. In suburban areas for example, transport patterns are characterized by higher car ownership rates, a stronger reliance on private cars, and longer travel distances. In contrast, residents of densely built, mixed-use inner-city neighbourhoods tend to conduct more activities within their immediate surroundings, resulting in reduced overall traffic volume. These findings highlight that both structural conditions and individual preferences influence mobility behaviour, questioning the correlation of effectivity and respective mobility measures. (Jarass 2012, pp. 27–28). However, in the conducted research, the focus has been placed primarily on structural and spatial aspects, indirectly addressing behavioural factors. As a result, the surveys ability to fully capture the interplay between individual preferences and structural influences on mobility behaviour remains limited.

[8] Survey Answer C4

### 4.3.2 Neighbourhood garages

Neighbourhood garages as an optional part of parking management, address the specific challenge of space efficiency by centralising parking spaces and freeing up on-street parking areas.

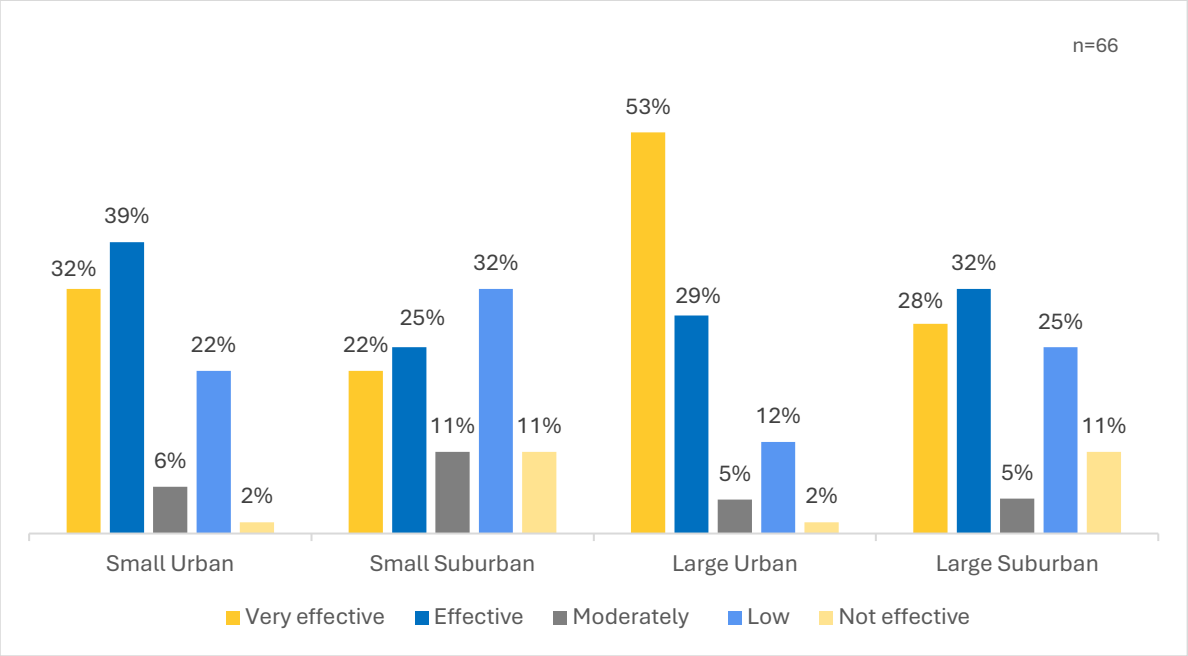



Figure 10: Impact relocating stationary traffic to enhance space for pedestrians.[9]

In urban neighbourhoods, 70-80 % see neighbourhood garages as very effective to effective (Figure 10 ↑).
This reflects the centralised parking facilities at the periphery of residential areas, as seen in Lincoln-Siedlung in Darmstadt and Vauban in Freiburg, which can free up valuable space within the neighbourhood centre for public spaces or greenery. The results support the perception that in densely populated neighbourhoods, the inconvenience of walking a short distance to a central parking facility is outweighed by the spatial benefits or high parking pressure. On the contrary, the lower ratings for suburban contexts align with the limitations discussed in the examples of Stellwerk 60 and Vauban, which show that the success of neighbourhood garages often depends on spatial separation, economic incentives, legal enforcement.
Furthermore, in Stellwerk 60, centralised parking is paired with a contractual- commitment by residents to car-free living and alternative mobility infrastructure, which is part of an extensive integration strategy and regulatory framework.

#### Implementation considerations

In suburban areas, where space is less constrained and reliance on cars remains structurally and culturally established, as the perceived effectiveness of neighbourhood garages decreases in the answers. While in urban neighbourhoods, the spatial and benefits and reduced stationary traffic are likely to be visible faster, in suburban contexts, where residents are especially used to doorstep parking convenience, these benefits may be less apparent.

[9] Survey Answer C2

In small suburban areas, only 22 % of experts view them as “very effective”, while 25 % rate them as “effective”. Besides the acceptance and effectivity, the size of a neighbourhood introduces additional complexities, particularly as smaller neighbourhoods who struggle to reach the economic viability, essential for shared mobility measures like car-sharing and cargo bikes or neighbourhood garages (Bauer et al. 2022a, p. 33). In contrast, larger and denser neighbourhoods offer the critical mass needed for the success of these initiatives.
Additionally, financial sustainability poses a significant challenge. Only relying on parking fees to finance these measures raises concerns about long-term feasibility. Furthermore, experts emphasise that the effectiveness of neighbourhood garages depends on the simultaneous implementation of parking management strategies within the neighbourhood. This interdependence will be further examined in chapter 4.4.

### 4.3.3 Bicycle Garages

Focusing on the technical and infrastructural elements that make cycling more convenient and practical, bicycle garages demonstrate how the Improve-dimension of the ASI framework promotes private bicycle use. In urban neighbourhoods, the combined effectiveness of bicycle garages is rated as mostly effective on average by 77 %, while in suburban neighbourhoods the effectiveness was estimated as “moderate” to “not effective” by 61 % (Figure 11). In small suburban neighbourhoods, the results indicate uncertainty regarding their utility in less densely populated suburban settings, as bicycles might not be the primary mode of transportation. The differences suggest the same conclusion for suburban locations, regarding lower densities, weaker public transport systems, and longer travel distances, which were discussed before in the context of parking management.

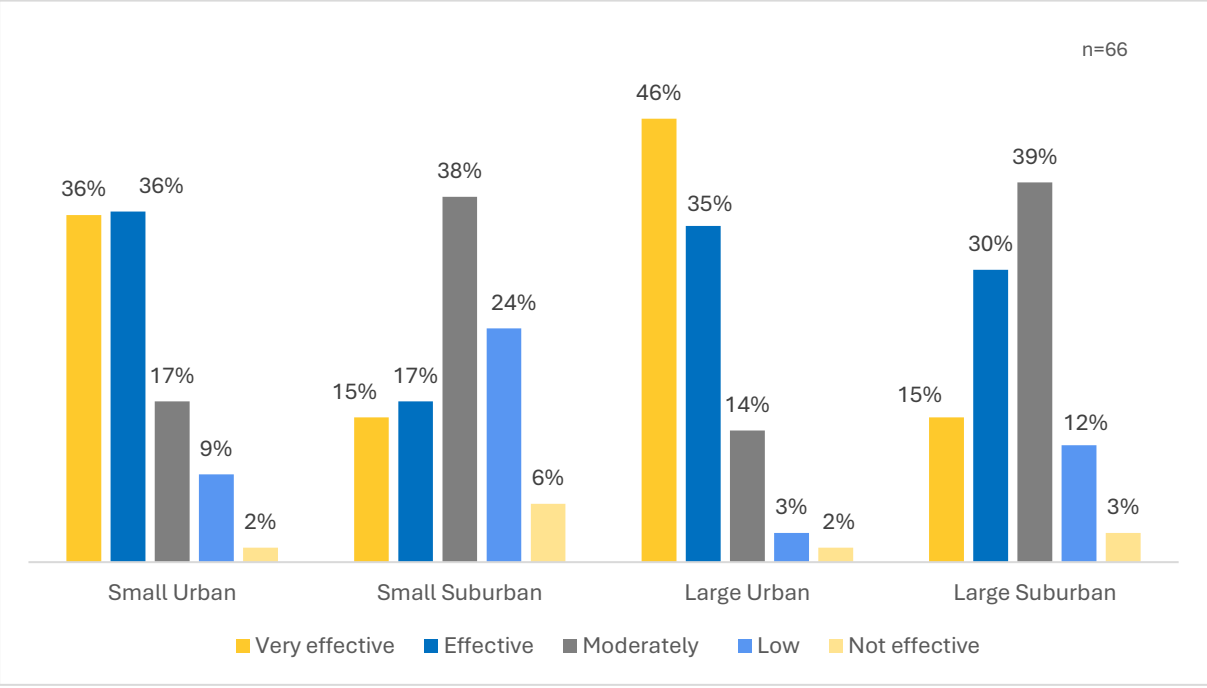



*Figure 11: Impact of bicycle garages on promoting private bicycle use.* [10]

[10] (single choice per Neighbourhood)

### 4.3.4 Mobility Flat rates

The limited application and mixed effectiveness of mobility flat rates draw parallels with the findings on bicycle garages, which highlighted significant urban - suburban disparities in promoting active transportation, as mobility flat rates reveal similar patterns of effectiveness in shifting private car use to public transport. Mobility flat rates remain furthermore among the least implemented measures, with only 7 % of respondents reporting successful implementation and an additional 7 % indicating they are in the planning stage (Figure 7). This significant gap in practical knowledge compared to other measures such as parking management or traffic-calming reflects the organisational complexity of this measure, with its operational challenges, including regulatory hurdles and financial feasibility. Although, experts' responses suggest despite low experience values of experts and low influence values during course of the survey in comparison to other measures, half of the respondents still attributed good effectiveness to mobility flat rates at the beginning (Figure 12).

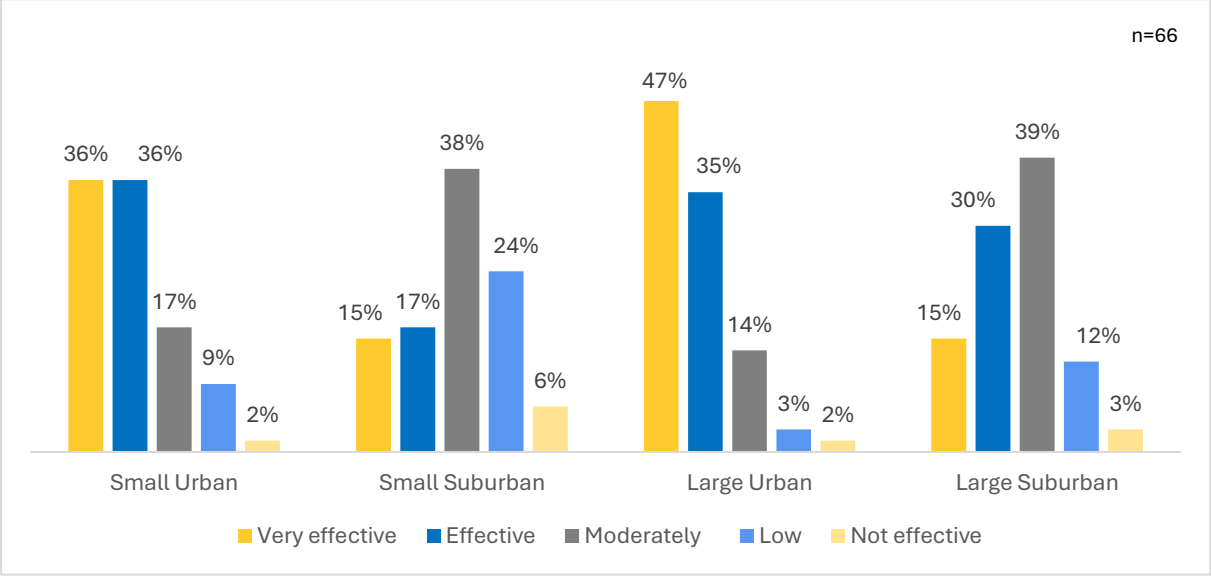



Figure 12:Impact of mobility flat rates on shifting private car use on public transport.

Considered individually, mobility flat rates are seen as most effective in large urban neighbourhoods, where 82% of respondents rate them as either very effective or effective (Figure 12↑). In small urban neighbourhoods, 71% shared this positive view, though slightly lower due to potential financial or infrastructure limitations.

In contrast, suburban areas require significant infrastructural and organisational improvements to achieve comparable results, as the data shows greater scepticism, with 43% of respondents in small suburban neighbourhoods and 36% in large suburban neighbourhoods rating them as either low or not effective. For these measures to succeed in suburban contexts, they must be paired with substantial investments in public transport expansion and last-mile connectivity solutions.

Nonetheless, mobility flat rates can be viewed from the Shift-Dimension (ASI) by incentivising the use of public transport and shared mobility services over private car use. In urban neighbourhoods, where multimodal infrastructure is well-developed, flat rates can function as a catalyst for behavioural change by providing financial and practical incentives. Therefore, to comprehensively assess the effectiveness of mobility instruments, it is crucial to account for both, the influence of spatial structures and the behavioural factors that drive mobility choices.

## 4.4 Combined Effect of Mobility Measures

This part will explore how these measures interact to create synergies and improve their combined impact in the neighbourhoods, observing how they influence car-dependence (Survey Block D and E). While individual measures play a role in shaping mobility behaviour, their full potential is realized when strategically combined to complement the spatial and infrastructural characteristics of a given neighbourhood (Blees and Gertz, p. 855). These pairing and their potentials to address car-dependence are described in the following chapters for urban and suburban neighbourhoods in the context of stationary traffic and public transport network.

### 4.4.1 Reducing Stationary Traffic – Block D

As demonstrated in chapter 2, reducing stationary traffic is a key component in neighbourhood mobility concepts to encourage car-reduced neighbourhoods. In the following findings, parking management is selected most frequently across all combinations. As seen in the C Block survey, this measure falls within the Avoid-Dimension of the ASI framework, as it discourages unnecessary car trips through spatial limitations. By addressing this objective, the instrument was chosen in urban neighbourhoods with 28–29 % and in small suburban neighbourhoods with 19-20 % (Figure 13).

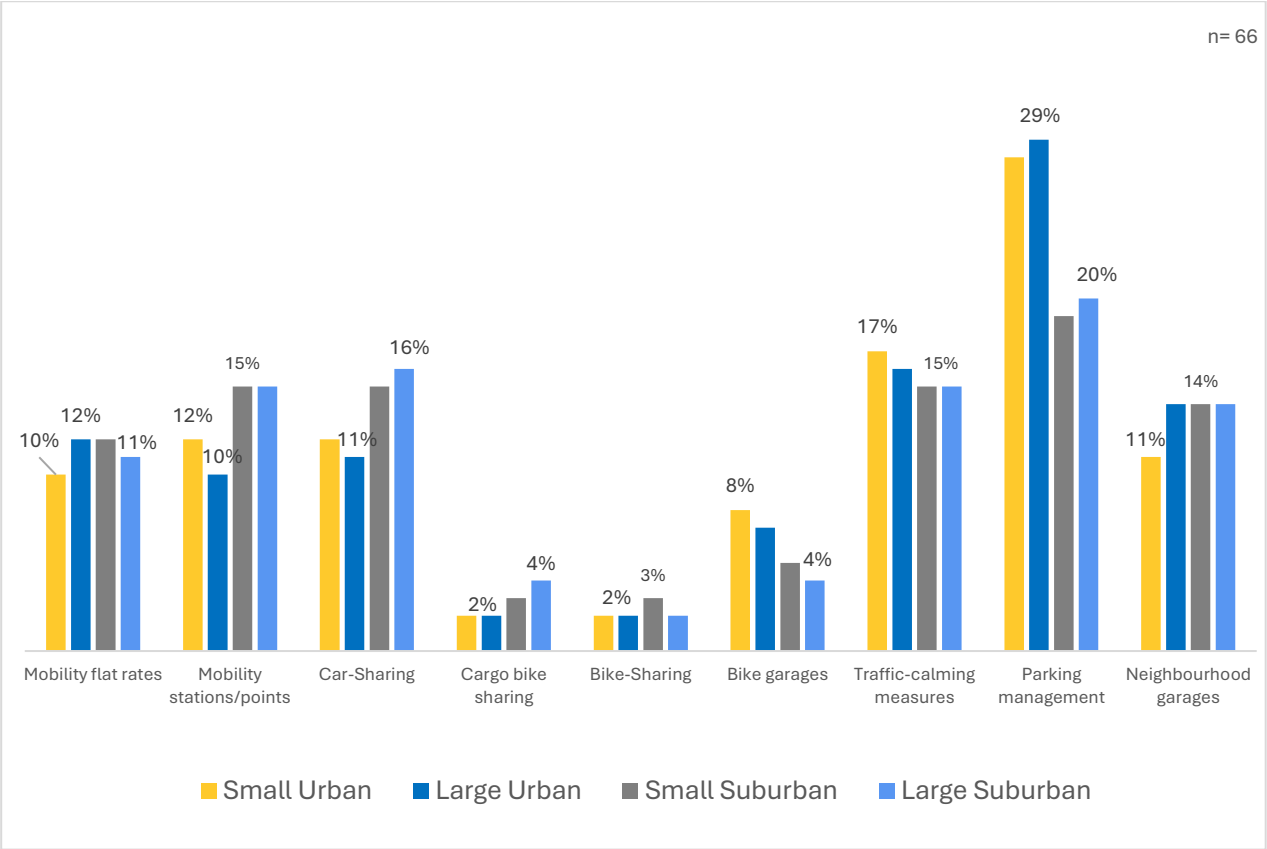



Figure 13: Reduce stationary traffic – Individual Measure Frequencies of Combinations by Neighbourhood.

The prioritisation of parking management is consistent across urban and suburban contexts, yet its relative dominance varies. In urban neighbourhoods, it is frequently paired with traffic-calming measures, (selected in 17 % of small urban neighbourhoods, 16 % of large urban neighbourhoods, and 15 % of suburban neighbourhoods), reinforcing Avoid strategies by limiting car accessibility. However, in suburban contexts, mobility stations (15%) and car-sharing (15 %) gain prominence, indicating an alignment with the Shift-Dimension by providing alternatives to car ownership.

On the contrary, instruments like cargo bike-sharing and bike-sharing are among the least selected measures (2–4 %) across the assessment, suggesting limited effectiveness in reducing stationary traffic within the examined neighbourhood types (Figure 13↑). Neighbourhood garages maintain a moderate but consistent presence, with 11–14 % in both urban and suburban neighbourhood types, primarily functioning as supporting infrastructure rather than standalone car-reduction measure. Bike garages receive some recognition but with declining frequencies from urban to suburban neighbourhoods, aligning with both the Improve and Shift -Dimensions by enhancing cycling infrastructure while supporting the continued adoption of environmentally sustainable transport options. Experts decided for this measure only in 8 % of every combination case in small urban neighbourhoods and 7 % in large urban ones.

Subsequently, 5 % choose them in small suburban neighbourhoods, and 4 % in large suburban neighbourhoods[11].

### Most Frequent Combinations in Urban Neighbourhoods

In large urban neighbourhoods, the most frequently selected measures include car-sharing, parking management, and neighbourhood garages, emphasizing the integration of shared mobility services and regulatory measures. This combination spans the Shift and Avoid-Dimensions, as it promotes car-sharing while simultaneously restricting private vehicle storage. In contrast, in small urban neighbourhoods this combination accounts only as the second option (Figure 14↓). The selection of mobility strategies varies significantly by neighbourhood size: larger urban neighbourhoods prioritise shared mobility services combined with controlled parking availability, whereas smaller neighbourhoods place a stronger emphasis on multimodal transport, integrating more balanced push & pull measures. The most commonly selected combination for small urban neighbourhoods, as assessed by experts, consists of traffic-calming, parking management and mobility stations or flat rates (Figure 14↓).

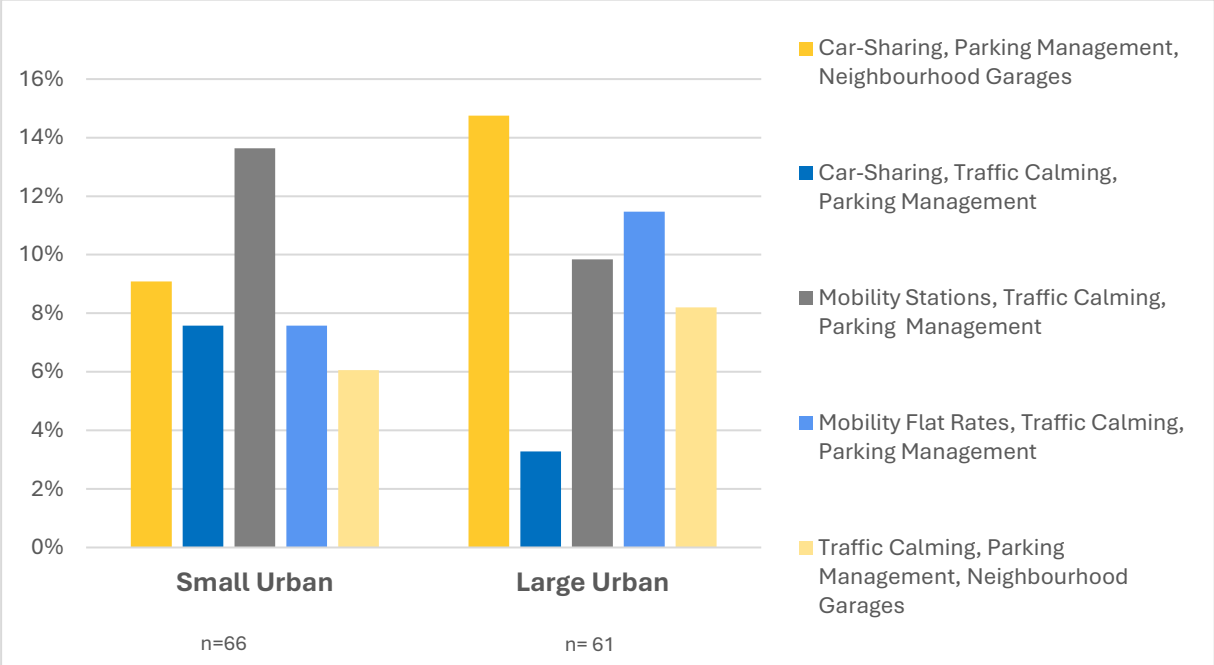



Figure 14: Most frequent combinations to reduce stationary traffic- Urban Neighbourhoods.[12]

This variation underscores the need for sustainable mobility concepts to be flexibly adapted to existing urban structures. Larger neighbourhoods prioritize shared mobility solutions, aligning with infrastructure and demand patterns, whereas smaller neighbourhoods. This variation underscores the need for flexible and context-specific mobility concepts. Larger neighbourhoods prioritize shared mobility solutions, aligning with infrastructure and demand patterns (Shift), whereas smaller urban neighbourhoods integrate a more balanced mix of Avoid

[11] Triple combinations with a total share of up to 72-73%, but less than 5% individually.
[12] Answers D1-D2

and Shift measures, emphasizing pedestrian-friendly environments and traffic-calming interventions (Appel et al. 2020, p. 182).
Most respondents (64–75 %) selected combinations with high diversity, resulting in combinations of three measure sets accounting in total less than 5% of cases and were therefore grouped as "other". The diversity underlines the importance of adapting mobility strategies to the specific needs of different neighbourhood types. Further analysis of two measures could provide nuanced insights into specific preferences, but this in-depth exploration exceeds the scope of this research.

### Most Frequent Combinations in Suburban Neighbourhoods

Suburban neighbourhoods exhibit different mobility trends compared to urban settings. The most frequently chosen combination in small suburban neighbourhoods includes car-sharing, parking management, and neighbourhood garages (12 %), reinforcing the Shift and Avoid-Dimensions by promoting shared mobility while regulating parking availability (Figure 15↓). In large suburban neighbourhoods, this combination appears even more frequently with 16 %, indicating a greater reliance on car-sharing when integrated with controlled parking access. Additionally, car-sharing, traffic-calming measures, and parking management remain relevant, appearing in 7 % of cases in small suburban neighbourhoods and 9 % in large suburban ones. Mobility stations, traffic-calming measures, and parking management are similarly chosen, with 7 % in small suburban neighbourhoods and 8 % in large suburban ones. Meanwhile, mobility flat rates, mobility stations, and traffic-calming measures are included in 5 % and 6 % of selections, respectively, in small and large suburban neighbourhoods. These patterns highlight a more varied selection of measures compared to urban contexts, with a focus on shared mobility and regulatory approaches.

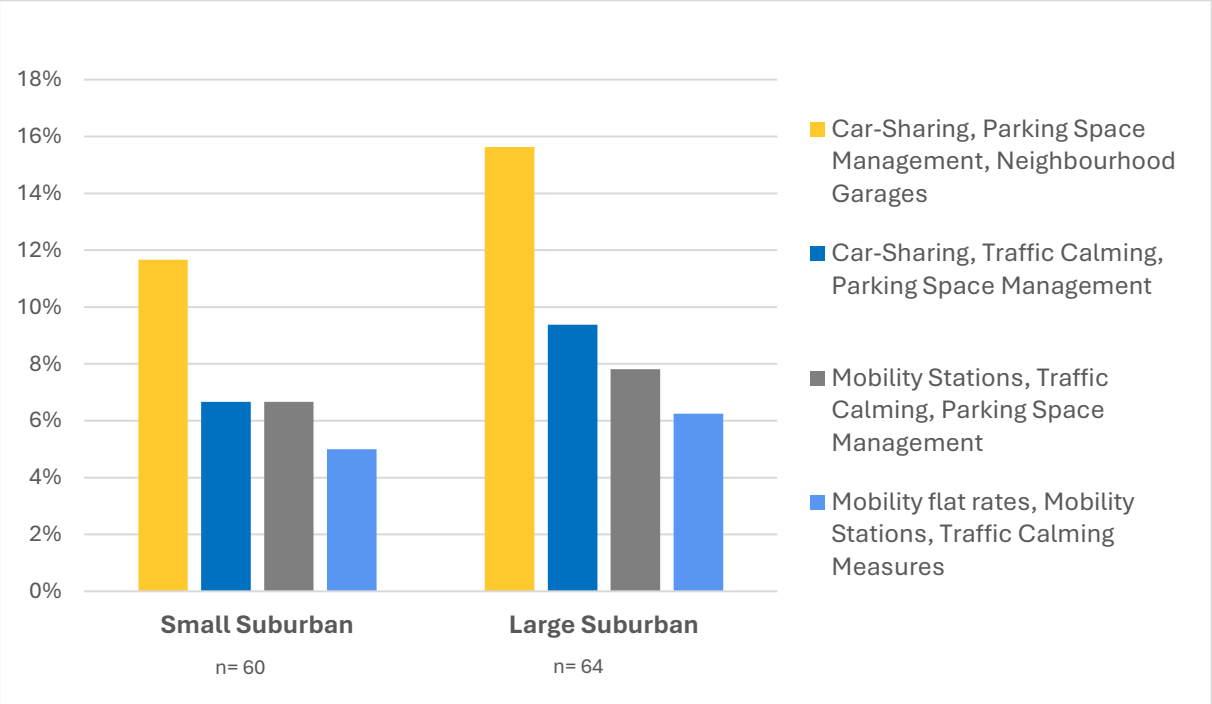



Figure 15: Most frequent combinations to reduce stationary Traffic- Suburban Neighbourhoods

Due to the high proportion of combinations falling below 5 % in frequency, the most repeatedly selected two-measure combination was analysed in small suburban neighbourhoods. Mobility stations and traffic-calming measures emerged as the most frequent pairing, appearing in 27 % of cases. This highlights the strong relationship between infrastructure improvements and traffic regulation in these contexts.

### Additional Measures to Avoid

In addition to the measures explicitly mentioned in the survey, several experts highlighted complementary strategies essential for effectively reducing stationary car traffic in neighbourhoods. A well-functioning and frequent public transport network, ideally including regional rail services, was frequently mentioned as a fundamental prerequisite for reducing car dependency. Some respondents also stressed the need for city tolls and environmental zones to limit unnecessary car trips and encourage sustainable alternatives. The following table condenses the expert suggestions into fields of action, which are proposed to complement the given mobility measures of this survey:

Public Transport & Mobility Alternatives: High frequency and accessible public transport, expansion of cycling and e-scooter infrastructure, and improved punctuality and connectivity of public transport.

Regulatory & Pricing Strategies: City tolls, environmental zones, street usage fees, strict enforcement of parking violations and illegal parking bans, and the elimination of individually assigned spaces in neighbourhood garages.

Reallocation of Public Space: Conversion of parking areas into green spaces, bike parking, and pedestrian zones; wider pavements; outdoor seating; play zones; and the removal of free public parking to push for car-free spaces.

Urban Planning & Parking Management: Systematic analysis of parking demand and supply (both public and private), integrated city planning, and parking space regulations.

Community Engagement & Awareness: Participatory planning with residents, communication on mobility alternatives and their benefits, and ensuring acceptance through visible improvements such as greenery, seating, and playgrounds.

## 4.4.2 Promote Shift towards Sustainable Modes of Transport – Block E

Encouraging a modal shift away from private car use towards walking cycling and public transport is a central objective in urban mobility planning. This section examines on basis of the survey data of Block E, how the four neighbourhood types prioritise specific measures to support this transition, comparing their prevalence in urban and suburban settings considering variations based on neighbourhood size. In contrast to Block D, which focused on reducing stationary traffic, Block E specifically evaluates instruments that directly promote the shift in mobility behaviour.

### Frequency of measures within combinations

Across all neighbourhood types, traffic-calming measures and parking management remain dominant, appearing frequently in selected combinations. Traffic-calming measures are chosen by 19 % in small urban, 17 % in large urban, 15 % in small suburban, and 14 % in large suburban neighbourhoods (Figure 16 ↓ illustrates the individual frequencies of mobility measures within the selected combinations, across different neighbourhood types). Similarly, parking management is prioritised by 19 % in both urban neighbourhood types and with 14 % in suburban neighbourhoods, emphasizing their foundational role as already seen throughout the previous assessment in various planning objectives. Additionally, mobility flat rates appear consistently across all neighbourhood types, with 18 % in small urban, 17 % in large urban, 20 % in small suburban, and 18 % in large suburban neighbourhoods. Compared to the previous planning objective (Figure 13↑), the broader distribution of selected measures indicates a more diverse approach, with mobility flat rates and mobility stations gaining greater prominence, particularly in suburban areas (Figure 16↓). Notably, in small suburban neighbourhoods, mobility flat rates emerged as the most frequently chosen measure in all combinations.

Car-sharing, in contrast, shows relatively low selection rates, with only 4 % in urban neighbourhoods and 7–8 % in suburban areas, ranking below cargo bike-sharing and bike-sharing, which range between 7–9 % across neighbourhoods. Neighbourhood garages are not even showed in any of the most frequently chosen combinations, resulting in a low individual frequency. In contrast, mobility stations show a stronger presence, with 12 % in urban and 18–19 % in suburban neighbourhoods, indicating their perceived importance in facilitating multimodal mobility solutions, particularly in lower-density environments.

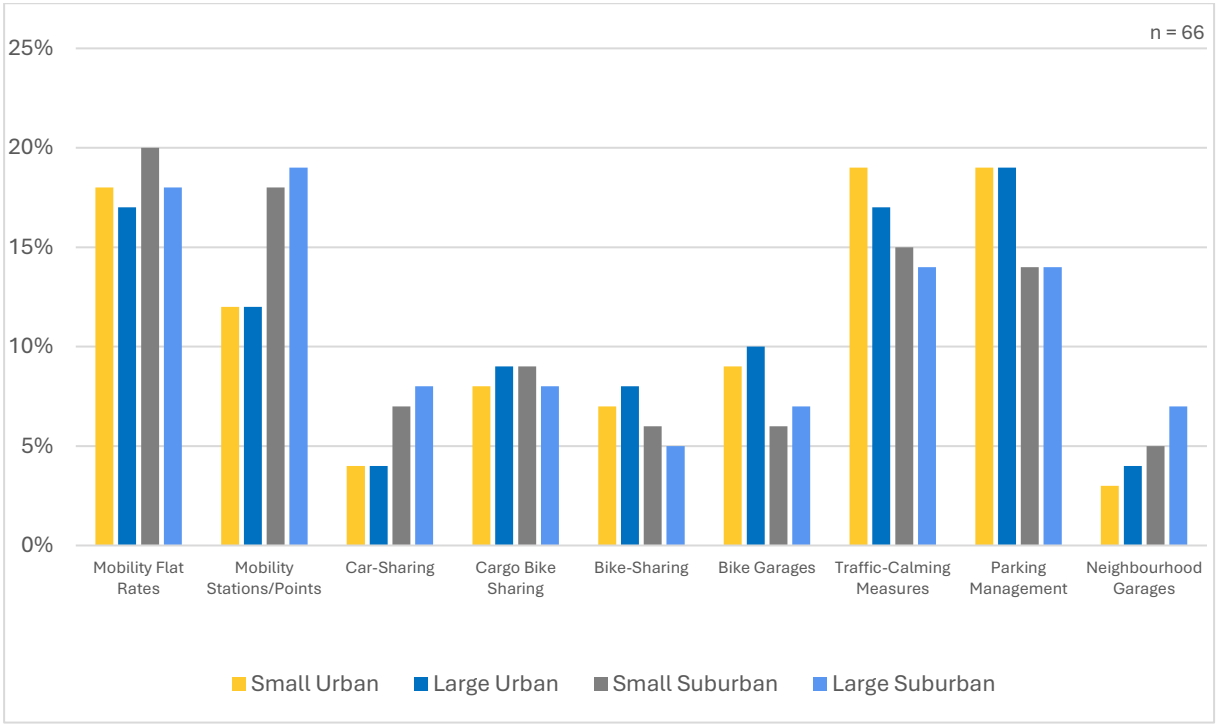



Figure 16[13]: Shifting towards sustainable transport- Individual measure frequencies of combinations by neighbourhood.

[13] Combination of answers E1- E5

### Most frequent combinations in urban neighbourhoods

In urban settings, the most frequently selected combination consists of traffic-calming measures, parking management, and mobility flat rates, with 18 % in small urban and 17 % in large urban neighbourhoods (Figure 17). This combination is particularly dominant in small urban neighbourhoods, where spatial constraints necessitate efficient integration of sustainable mobility solutions. The second most frequent combinations differ by size: small urban neighbourhoods prioritise mobility stations alongside traffic-calming and parking management, whereas large urban neighbourhoods favour mobility flat rates, mobility stations, and parking management. Notably, car-sharing does not feature in the most common urban combinations, highlighting a preference for infrastructural and service-based mobility solutions over shared vehicle schemes.

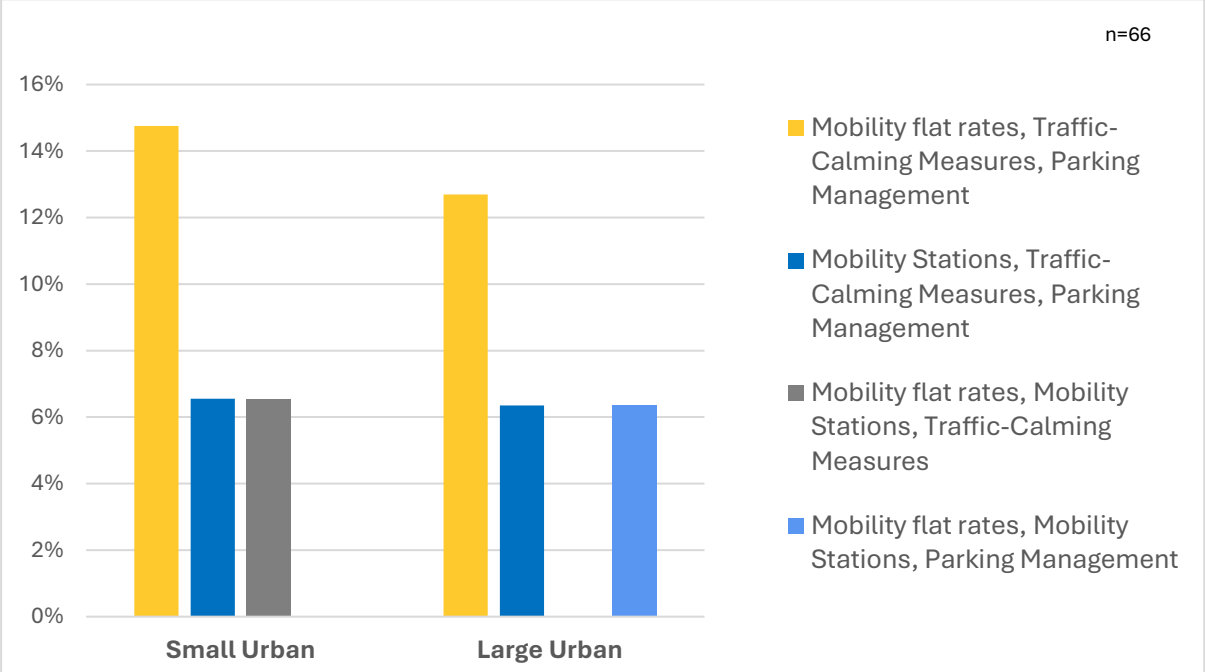



Figure 17[14]: Most frequent combinations to promote Shift-Dimension (ASI)- Urban Neighbourhoods

### Most frequent combinations in suburban neighbourhoods

In suburban neighbourhoods, the most frequent combinations include mobility flat rates, mobility stations, and traffic-calming measures, appearing in 15 % of small urban and 13 % of large urban neighbourhoods (Figure 18 ↓). Small suburban neighbourhoods exhibit a stronger preference for mobility flat rates and mobility stations, each appearing in 10% of the most common combinations. Large suburban neighbourhoods, however, show a slightly more varied distribution, incorporating mobility stations, mobility flat rates, and traffic-calming measures at rates between 5–8%. Notably, neighbourhood garages are absent from the most frequently selected suburban combinations, reinforcing a preference for distributed parking solutions rather than centralised storage facilities.

[14] Answers E1-E2

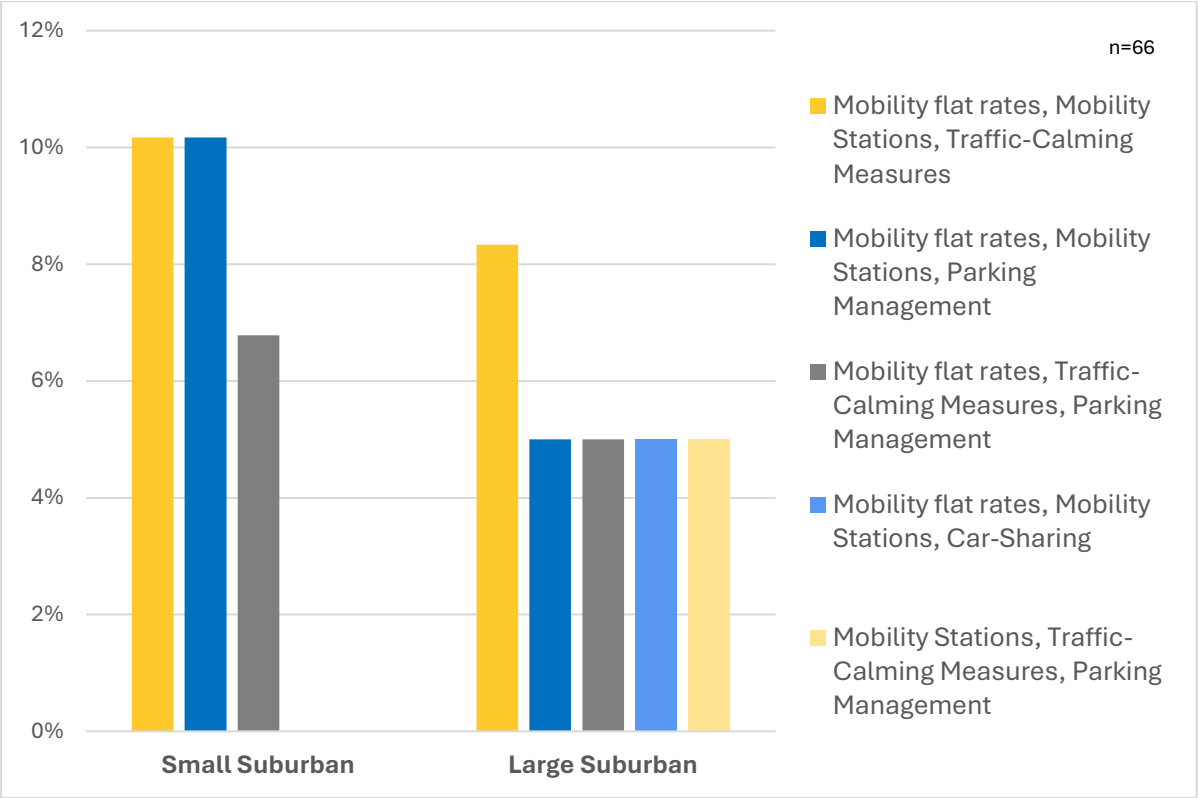



Figure 18: Most frequent combinations to promote Shift-Dimension (ASI)- Suburban Neighbourhoods

Compared to urban neighbourhoods, where parking management and traffic-calming measures play a dominant role in restricting car use, suburban neighbourhoods rely more heavily on service-based incentives to facilitate modal shifts. The cross-neighbourhood comparison highlights a broader trend: urban neighbourhoods leverage space-efficient measures that manage car presence directly, whereas suburban neighbourhoods compensate for lower densities by enhancing accessibility to alternative mobility services. This contrast underscores the different planning priorities necessary for effective modal shift strategies in varying spatial contexts.

### Additional measures to promote Shift-Dimension

Beyond the core measures, experts highlighted several additional interventions that could enhance the shift from car use to walking, cycling, and public transport in neighbourhoods. A consistent theme was the improvement of public space and active mobility infrastructure, with suggestions such as expanding pedestrian and cycling infrastructure, reallocating parking spaces for bike hubs, and lowering speed limits. Improving public transport connectivity through improved frequency, accessibility, and last-mile solutions was another key aspect. From a regulatory perspective, experts pointed out the need for congestion pricing, stricter parking enforcement, and financial incentives for sustainable mobility. Moreover, the integration of urban and transport planning emerged with a focus on aligning policies to reduce car dependency, conducting detailed parking analyses, and promote public participation to

increase acceptance for the mobility transition. The following table shortens the suggestions of experts made in the open-ended question of the survey[15]:

Public Space and Active Mobility

- Expand cycling and pedestrian infrastructure (wider pavements, protected bike lanes, superblocks).
- Reallocate car parking for bike parking, shared mobility hubs, and green spaces.
- Lower speed limits (citywide 30 km/h, targeted 20 km/h zones).

Public Transport and Connectivity

- Improve frequency, punctuality, and accessibility of public transport.
- Ensure short walking distances to transit hubs and seamless last-mile connections.
- Implement barrier-free infrastructure at bus stops and stations.

Policy and Regulation

- Introduce congestion pricing, city tolls, and environmental zones.
- Enforce strict penalties for illegal parking and traffic violations.
- Remove tax incentives for private car use and introduce financial incentives for sustainable transport.

Integrated Planning and Governance

- Align urban and transport planning to reduce car dependency.
- Conduct parking space analyses to assess supply, demand, and reallocation potential.
- Strengthen public engagement and communication to enhance acceptance of mobility measures.

The following chapter critically examines the findings of the study, contextualizing them within existing research and identifying key implications for sustainable mobility planning. It discusses the interplay between push and pull measures, evaluates the alignment of observed combinations with the Avoid-Shift-Improve (ASI) framework, and reflects on potential methodological limitations and future research directions.

[15] Appendix: Survey E5

# 5. Discussion

This chapter discusses the findings in a rather comparative approach including the framework ASI- dimensions, the role of push-and-pull measures, urban suburban disparities and assesses the transferability of the findings, not only across the four neighbourhood types. Further, the chapter integrates additional insights from expert survey-responses to contextualize the results within practical constraints such as governance, financing, and public acceptance. Finally, the chapter outlines the practical implications for urban mobility planning, evaluates the limitations of this study, and possibilities for future research.

## 5.1 Urban and suburban dynamics

The examined effectiveness of individual implemented measures, linked to distinct planning objectives, reveal's significant differences, urban and suburban neighbourhoods. In densely populated urban areas, where spatial constraints are most acute, restrictive measures such as parking management are rated exceptionally high with 80 to 90 % as "very effective" or "effective" (Table 2↓). This strong approval reflects the foundational role of parking management in urban environments, where limited space seems to correlate with regulatory control over car parking space availability. The findings thereby directly contributing to correlation of car ownership and availability of parking space (Göhlich and Raab 2021, p. 102), aligning with Münsch and Lell's (2024) argument that parking management serves as a critical demand-side control mechanism by increasing the cost and reducing the accessibility of private vehicles.

In suburban neighbourhoods, the effectiveness of parking management is notably lower, with approximately 50% of respondents rating it as effective (Table 2↓). This disparity can be attributed to the lower population density and greater spatial flexibility in suburban neighbourhoods, which generally offer more abundant parking options and less immediate pressure on public space. As a result, the direct impact of restrictive measures in these areas is less pronounced.

Table 2: Summary of Single Measure Effectiveness (Block C) across Planning Contexts.

| Measure | Urban Neighbourhoods | Suburban Neighbourhoods | Key Observations |
|---|---|---|---|
| **Parking Management** | • High effectiveness (80-90 % rate as effective/very effective).<br>• Reduces car dependency and reallocates space. | • Moderate effectiveness (50%)<br>• Limited by car-dependence and fewer alternatives. | • Effectiveness linked to density and accessibility.<br>• Suburban neighbourhoods require especially extension of public transport options. |
| **Neighbourhood Garages** | • Effective (70-80 %)<br>• Creates public spaces by centralising parking. | • Limited effectiveness.<br>• Resistance due to convenience of doorstep parking. | • Financial viability challenges in suburban neighbourhoods. |
| **Bicycle Garages** | • Effective (77 % rate as effective). Promotes cycling through improved infrastructure. | • Moderate to low effectiveness (61 % rate as moderate/not effective).<br>• Cycling less prominent. | • Success depends on density, public transport availability, and proximity to destinations. |
| **Mobility Flat Rates** | • Very effective in large urban neighbourhoods (82 % rate as effective/very effective).<br>• Supports multimodal systems. | • Less effective in suburban neighbourhoods (43-36% rate as low/not effective).<br>• Infrastructure gaps are significant. | • Tied to dense transport networks; suburban neighbourhoods need significant investment in services. |

Neighbourhood garages, which centralize parking to free up public space, also display a marked contrast between urban and suburban contexts. In urban neighbourhoods, 70–80% of experts find these garages effective, likely because the inconvenience of having to walk a short distance to a central parking facility is offset by the benefits of reclaiming valuable urban space. In suburban areas, however, where residents are more accustomed to doorstep parking and the spatial dynamics differ, only about 22–25% of respondents consider neighbourhood garages very effective. This suggests that the benefits of centralised parking are less tangible in environments where space is less of a premium.

Bicycle garages as instrument, which improve cycling infrastructure, are perceived as moderately effective in both settings, but with higher ratings in urban areas (77% effective on average) compared to suburban areas (around 61%). The lower effectiveness in suburban

contexts may reflect a reduced demand for cycling alternatives in areas with lower densities and longer travel distances, where private car use is more deeply entrenched.
Mobility flat rates also exhibit a clear urban–suburban divide. In urban neighbourhoods, especially in larger ones, 82% of respondents rate mobility flat rates as very effective or effective, while in small urban areas the rating is slightly lower at 71%. In contrast, suburban areas show significant scepticism, with only 43% of small suburban and 36% of large suburban respondents considering mobility flat rates effective. This suggests that without substantial improvements in public transport connectivity and last-mile solutions, the potential of mobility flat rates to promote a modal shift is constrained in suburban environments.

### Size and housing units

Besides the location the differentiation of neighbourhoods based on a threshold of one hundred housing units was based on extensive preliminary discussions with experts and insights from the financing practices of mobility-related projects. Consultations with Bremen's advisory office for mobility project developers, who plan mobility concepts to substitute parking spaces in context of the mobility construction local law, revealed that the feasibility and structure of mobility solutions primarily depend on the size of a given project. While this advisory office also works on projects with less than 30 housing units, it became clear that for the purposes of this research, a consistent threshold was necessary to ensure the practical applicability of mobility measures for the development of the survey. Since financing remains fundamental to the implementation and viability of mobility measures, such as car-sharing, a categorization was developed in collaboration with the DLR to ensure the transferability of findings while maintaining survey clarity. Nevertheless, this financial aspect could not be taken up thematically in this work but played an important fundamental role in the operationalization of the survey. It turns out that the limit of one hundred housing units is regarded as a practicable reference value in order to differentiate between challenges and implementation potentials.

## 5.2 Combining Shift- and Avoid-Dimension

The preference in Block D on measures that primarily restrict private car use through spatial and regulatory intervention, aligning with the Avoid-dimension can be seen in the high frequency parking management was selected across both urban and suburban contexts. In urban neighbourhoods, it is often combined with traffic-calming measures, underscoring a strategy that physically limits the convenience of car use. In suburban neighbourhoods, parking management remains important, but alternatives such as mobility stations and car-sharing gain relative importance.
Complementary, the promotion of a modal shift from private cars to walking, cycling, and public transport which was asked for in Block E emphasizes in urban neighbourhoods' traffic-calming, parking management, and mobility flat rates as most common combination. In suburban neighbourhoods the variation increases, as experts selected mobility flat rates and mobility stations more frequently. Although both blocks combine likewise measures, the roles they play differ; in Block D these instruments are used to restrict car accessibility, whereas in Block E they function to incentivize alternative modes of transport. Notably, several instruments exhibit dual roles, simultaneously addressing both the Avoid and Shift-Dimensions of the ASI framework. For

instance, traffic-calming measures emerge as a foundational element in both blocks. In Block D, they function as a classic Avoid measure by restricting unnecessary car trips through spatial limitations. However, their role is not limited to merely reducing car usage; they also create a safer, more inviting environment that facilitates a modal shift toward walking and cycling. This dual functionality suggests that certain measures can serve as the groundwork upon which additional Shift strategies can build. In other words, without effective traffic-calming, the subsequent introduction of more specialized measures, such as bicycle garages, might not yield their full potential.
Another instrument which is combined in various planning objectives of the survey is car-sharing, while traditionally associated with reducing private car ownership, also contributes to the Improve-Dimension (SenMV Bremen 2020). Focusing on the efficiency through the increasing the utilization rate of shared cars compared to individually owned cars, it complements both Avoid and Shift strategies. Also bicycle garages offer another instructive example. Their primary function is to improve cycling infrastructure by providing secure and convenient parking for bicycles, aligning them with the Improve-Dimension. However, their effectiveness is contingent upon an existing demand for cycling, which typically only emerges after initial measures, such as traffic-calming and other Shift-oriented strategies, have successfully made cycling a more attractive alternative to car use. Thus, bicycle garages are best understood as a subsequent, supportive measure that reinforces the modal shift once a sufficient behavioural change has been initiated but are Indispensable to aim for a transition. Though, current literature of mobility concepts and preliminary discussions indicate that car-sharing in combination with cargo bike- sharing could have a synergistic effect (Becker et al. 2019, p. 162). However, the findings did not reconfirm that assumption in the context of this research as instruments such as cargo bike-sharing were hardly selected. This dual approach demonstrates that effective mobility strategies must integrate both restrictive (Avoid) and incentive-based (Shift) measures to address the complexity of mobility while using all the chances of technological improvement (Bauer et al. 2022a, p. 34).

### 5.2.1 Additional Measures proposed by Experts

Beyond the core instruments, experts proposed complementary strategies to address planning objectives of a sustainable mobility transition (Chapter 4.4.2 and 4.4.4). In context of enhancing a modal Shift the experts proposed in the open-ended questions to expand sustainable mobility options and the local public transport systems, not only by improving frequency and punctuality but also by ensuring robust last-mile connectivity. Also, enhancing active mobility infrastructure through e.g. the expansion of cycling was seen as essential to incentivize non-motorized travel. Additional regulatory and pricing measures, such as the introduction of city tolls, environmental zones, and street usage fees, were also named to restrict car use and increase the appeal of alternative options. Finally, experts highlighted the importance of clear, initiative-taking communication and direct stakeholder engagement. They argued that involving residents early in the planning process, beyond merely informing them, can help mitigate resistance and build support for these measures. These findings were also promoted within the used literature of this research (Pietron et al. 2021, p. 69), especially in the evaluation of the Ottensen Neighbourhood in Hamburg and the evaluation of the local law on car parking spaces

(Bezirksamt Altona 2019; Hamburg SenMV Bremen 2020). The Lincoln- Siedlung included the idea from the beginning additionally within the overall neighbourhood development, by an associated mobility counselling offer for residents.

### 5.2.2 Implementation Challenges and Barriers

Alongside these proposed measures, several implementation challenges were named in the last part of the survey (Block F) which align with previous notes towards participation. By many experts, the resistance encountered, when introducing push measures that restrict car use, was stated. Even though measures like parking management have proven effective in limiting car dependency, they allegedly often face opposition from residents who perceive such restrictions as a loss of flexible mobility, especially when not applied only privately but also publicly. (Blees and Gertz, p. 855)

Furthermore, the participants mention political and financial constraints complicating the implementation process. Pointing out that political reluctance, rooted in short-term electoral considerations, can hold back the adoption of measures that are necessary for long-term mobility transitions. Additionally, limited municipal budgets and the deficiency of dedicated funding streams, such as long-term subsidies or public–private partnerships, pose significant barriers to executing ambitious mobility projects.

In preliminary discussions, professionals from state owned housing companies had indicated that, although they have a high-level of specific knowledge about the respective neighbourhoods, they have hardly any financing options for their own implementation of most mobility measures. Subsequently it results in a lack of expertise to answer the survey questions completely and explaining the high dropout rate of almost 50%. Nonetheless, the interviewed experts, are significantly involved in municipal planning and transportation design which can be seen in the high prevalence in the beginning survey questions. The self-selection underlines the fact that the results are based on solid practical relevance, even if the group of interviewees is small and specialized.

Another challenge highlighted by the experts is the operational complexity of implementing integrated mobility solutions. For instance, while mobility flat rates offer a promising incentive-based approach, their success depends on overcoming regulatory hurdles and ensuring sufficient user demand, issues that remain unresolved in many suburban contexts. The interplay of these factors collectively underscores the difficulties in achieving a comprehensive sustainable mobility transition. The combined analysis of additional measures and implementation challenges demonstrates that a sustainable mobility transition depends not only on selecting effective instruments but also on addressing significant practical barriers. Besides expanding the range of mobility options through infrastructural and regulatory improvements, experts encourage a simultaneous tackle of political, financial, and operational obstacles.

Furthermore, it is also important to contextualise the integrated approach into a broader frame of sectoral transitions in Germany as urban mobility transition as well cannot be achieved on its own but requires the integration of multiple sectors, transport, energy, housing, and urban planning. The interlinking of these, improves the overall efficiency and effectiveness of mobility strategies. By aligning infrastructural developments, technological innovations, and policy

frameworks across these interconnected areas, cities can create synergies that not only reduce private car dependency but also promote a modal shift. This comprehensive approach ensures that measures such as parking management, mobility flat rates, and active mobility infrastructure are supported by complementary energy and housing policies, enabling the way for a comprehensive, citywide transformation.

# 6. Conclusion and Outlook

This study has examined the role of mobility concepts in urban and suburban neighbourhoods in Germany in context of reducing car dependency and identifying differences in the effectiveness and prioritization of mobility measures across these contexts. The analysis of findings revealed that restrictive measures such as parking management and traffic-calming play a more dominant role in urban environments, whereas suburban areas rely further on incentive-based measures. The findings confirm that push and pull strategies must be adapted to local conditions, as measures that effectively reduce car dependency in dense urban neighbourhoods may be less impactful in suburban areas with weaker public transport infrastructure and greater reliance on private vehicles.
A key takeaway is that individual mobility measures do not function in isolation but instead work through synergies within broader mobility strategies. While survey- block D highlighted the importance of parking management and spatial regulation in reducing stationary car traffic, block E demonstrated the role of incentivizing public transport and active mobility options to shift travel behaviour. The analysis within the Avoid-Shift-Improve (ASI) framework further found out that urban areas, with their spatial limitations and partially existing multimodal transport infrastructure integrate Avoid and Shift strategies combined more effectively, than suburban neighbourhoods, which remain more dependent on incentivising measures within the Shift-Dimension (ASI) and with fewer restrictive interventions. They require significant investment in alternative transport services to create viable mobility options before restrictive measures can be implemented successfully. From a policy perspective, the results emphasize the necessity of differentiated strategies that account for neighbourhood characteristics rather than adopting a one-size-fits-all approach.
The findings also point out the importance of integrating push and pull measures to maximize effectiveness. The analysis of survey-responses in Block F showed that restrictive measures often face strong public resistance, particularly when implemented without viable alternatives. This aligns with case study evaluations of Vauban, Lincoln-Siedlung, and Ottensen, where the success of mobility concepts depended not only on spatial interventions but also on early and participatory engagement with residents. These findings contribute to the broader academic discourse on urban mobility governance, reinforcing the view that public acceptance and institutional coordination are as critical as the technical design of mobility measures.

While this research provides valuable insights, it is subject to certain limitations. The survey sample primarily consisted of mobility experts, which cannot fully capture the perspectives of residents and end-users. Additionally, the categorization of neighbourhoods based on size and location, while methodologically essential, does not fully reflect the diverse socio-economic, infrastructural, and political contexts that influence mobility behaviour in neighbourhoods.

Further research could address these limitations by conducting longitudinal studies to assess the impact of implemented measures in more detailed settings and observe whether initial effectiveness translates into long-term behavioural change in respective settings. Future studies could also include user-focused surveys to understand how and which groups of residents perceive and interact with different mobility measures in practice. Additional research of the financial feasibility and governance structures that support mobility transitions would provide deeper insight into the institutional challenges that influence the adoption of these measures as well.

The transition to sustainable urban mobility requires more than just technical solutions and infrastructure development, it demands a comprehensive approach that integrates urban planning, public policy, financial incentives, and behavioural change strategies.
To fully grasp the significance of the mobility transition, it is crucial to recognize that sustainable urban mobility cannot be achieved in isolation but requires the integration of multiple sectors, transport, energy, housing, and urban planning. The disciplinary combination, or as well as the coordinated interlinking of (transition) sectors, enhances the overall efficiency and effectiveness of mobility strategies. By aligning infrastructural developments, technological innovations, and policy frameworks across these interconnected areas, cities can create systemic synergies that not only reduce private car dependency but also promote a shift towards more sustainable, multimodal transport systems. This comprehensive approach ensures that measures such as parking management, mobility flat rates, and active mobility infrastructure are supported by complementary energy and housing policies, ultimately paving the way for a comprehensive, citywide transformation.
This study highlights the critical role of neighbourhood-level mobility concepts in shaping broader urban transport transitions, demonstrating that while certain measures are widely effective, their implementation remains contingent on local context, political will, and public engagement. By assessing mobility measures on their effectiveness in different spatial and planning settings, this research contributes to the ongoing discourse on sustainable mobility planning and the systematic evaluation of mobility concepts in neighbourhoods. However, achieving meaningful change will require continued adaptation, interdisciplinary collaboration, and stronger integration of local stakeholder perspectives. As urban mobility continues to go new ways, policy flexibility, innovative governance, and community-driven approaches will be essential in ensuring that mobility transitions are not only technically feasible but also socially and politically sustainable. The transition of mobility will therefore not be achieved through singular interventions but through the persistent, repetitive alignment of policy, infrastructure, and user behaviour, ensuring that sustainable mobility becomes not just an alternative, but the usual.

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# 8. Appendix- Questionnaire

# Wirksamkeit von Mobilitäts-maßnahmen in Quartieren

## Willkommen zur Umfrage - bis zum 22.11.2024 (Verlängerung 23.12.2024)

Sehr geehrte/r Teilnehmer/in,

Ziel dieser Umfrage ist es, durch Ihre fachliche Einschätzung, die Wirksamkeit von mobilitätsfördernden Maßnahmen in Quartieren zu verstehen. Im Mittelpunkt steht die Verlagerung der privaten Pkw-Nutzung hin zu nachhaltigen Mobilitätsangeboten. Da ein Großteil der täglichen Mobilität im Wohnumfeld beginnt, bieten sich Quartiere besonders an, um durch gezielte Mobilitätskonzepte einen wichtigen Beitrag zur Mobilitäts- und Verkehrswende zu leisten.

Die Umfrage ist Teil einer Masterarbeit an der TU Darmstadt, welche im Rahmen des Projekts „Vernetzte Mobilität für lebenswerte Orte“ des Instituts für Verkehrsforschung am Deutschen Zentrum für Luft- und Raumfahrt (DLR) durchgeführt wird. In diesem wird unter anderem die Konzeption eines Werkzeugs erarbeitet, das Akteure bei der Planung und Umsetzung von Mobilitätsmaßnahmen und Mobilitätskonzepten auf Quartiersebene unterstützt.
Ich würde mich freuen, wenn Sie sich ca. **10 Minuten** Zeit nehmen, um die Fragen zu beantworten. Es werden keine personenbezogenen Daten erhoben. Ihre Antworten werden anonym und ausschließlich im Rahmen der wissenschaftlichen Forschung verwendet.

Bei Interesse an den Ergebnissen der Umfrage oder weiteren Fragen, kontaktieren Sie mich gerne unter **ayush.sharma@stud.tu-darmstadt.de**

Vielen Dank für Ihre Unterstützung!

Block A

## Teil A: Zur Person

**In welcher Art von Institution/ Unternehmen sind Sie tätig?**

- ○ Öffentliche Verwaltung
- ○ Freies Planungsbüro
- ○ Kommunales Wohnbauunternehmen
- ○ Wohnungs- / Immobilienwirtschaft
- ○ Forschungseinrichtung
- ○ Sonstiges (bitte nennen) [ ]

**Welche Mobilitätsangebote/ -maßnahmen der folgenden Auswahl haben Sie bereits in Wohnquartieren umgesetzt bzw. planen Sie umzusetzen?**

| | In Planung | Umgesetzt | Keine direkte Erfahrung | Keine Antwort |
|---|---|---|---|---|
| Mobilitätspauschalen (Zugang zu verschiedenen Mobilitätsdiensten inkl. ÖPNV. Im Mietpreis enthalten oder vergünstigt) | ○ | ○ | ○ | ◉ |
| Mobilitätsstationen/-punkte | ○ | ○ | ○ | ◉ |
| Car-Sharing | ○ | ○ | ○ | ◉ |
| Lastenrad-Sharing | ○ | ○ | ○ | ◉ |
| Bike-Sharing | ○ | ○ | ○ | ◉ |
| Fahrradgaragen (Im/Vor Gebäude) | ○ | ○ | ○ | ◉ |
| Verkehrsberuhigende Maßnahmen (Umwidmung Fahrradstraßen, Einbahnstraßen, Tempo 30 Zonen) | ○ | ○ | ○ | ◉ |
| Parkraummanagement/ -bewirtschaftung (Reduzierte Stellplätze, Kostenerhöhung) | ○ | ○ | ○ | ◉ |
| Quartiersgaragen | ○ | ○ | ○ | ◉ |

Zurück Weiter

Block B

## Teil B: Allgemeine Einschätzung

**Wie wirksam schätzen Sie die jeweilige Maßnahme der folgenden Auswahl im Allgemeinen zur Förderung der Mobilitäts-/ Verkehrswende im Wohnumfeld ein?**

| | Nicht wirksam | Sehr wirksam |
|---|---|---|
| Mobilitätspauschalen | | |
| Mobilitätsstationen/-punkte | | |
| Car-Sharing | | |
| Lastenrad-Sharing | | |
| Bike-Sharing | | |
| Fahrradgaragen | | |
| Verkehrsberuhigende Maßnahmen | | |
| Parkraummanagement/ -bewirtschaftung | | |
| Quartiersgaragen | | |

Zurück

Weiter

Block C

## Teil C: Bewertung Einzelner Maßnahmen

*Diese Umfrage unterscheidet in **vier** verschiedene Quartiere, welche anhand der **Lage** (innerstädtisch🏢 und randstädtisch🏠) und **Größe** (unter/über 100 Wohneinheiten🏠/🏢/🏠🏠/🏢🏢) ausgewählt wurden.*

**Tipp 💡 Verkleinern Sie den Zoomfaktor von Ihrem Browserfenster (60-70%) für eine bessere Übersicht.*

**Wie wirksam ist das Angebot von Fahrradgaragen, um die Nutzung privater Fahrräder, unabhängig von der Radweginfrastruktur, in den jeweiligen Quartieren attraktiver zu gestalten?**

| | Sehr wirksam | Wirksam | Mäßig | Gering | Nicht wirksam | Keine Antwort |
|---|---|---|---|---|---|---|
| Innerstädtisches Quartier mit <100 Wohneinheiten 🏢 | ○ | ○ | ○ | ○ | ○ | ◉ |
| Innerstädtisches Quartier mit >100 Wohneinheiten 🏢🏢 | ○ | ○ | ○ | ○ | ○ | ◉ |
| Randstädtisches Quartier mit <100 Wohneinheiten 🏠 | ○ | ○ | ○ | ○ | ○ | ◉ |
| Randstädtisches Quartier mit >100 Wohneinheiten 🏠🏠 | ○ | ○ | ○ | ○ | ○ | ◉ |

**Wie wirksam ist die Verlagerung und Bündelung des ruhenden Pkw-Verkehrs in Quartiersgaragen, um mehr Raum für zu Fuß Gehende zu schaffen?**

| | Sehr wirksam | Wirksam | Mäßig | Gering | Nicht wirksam | Keine Antwort |
|---|---|---|---|---|---|---|
| Innerstädtisches Quartier mit < 100 Wohneinheiten | ○ | ○ | ○ | ○ | ○ | ◉ |
| Innerstädtisches Quartier mit > 100 Wohneinheiten | ○ | ○ | ○ | ○ | ○ | ◉ |
| Randstädtisches Quartier mit < 100 Wohneinheiten | ○ | ○ | ○ | ○ | ○ | ◉ |
| Randstädtisches Quartier mit > 100 Wohneinheiten | ○ | ○ | ○ | ○ | ○ | ◉ |

**Wie wirksam ist das Angebot der Mobilitätspauschale (inkl. ÖPNV-Ticket), um private Pkw-Nutzung auf den ÖPNV in den verschiedenen Quartieren zu verlagern?**

| | Sehr wirksam | Wirksam | Mäßig | Gering | Nicht wirksam | Keine Antwort |
|---|---|---|---|---|---|---|
| Innerstädtisches Quartier mit < 100 Wohneinheiten | ○ | ○ | ○ | ○ | ○ | ◉ |
| Innerstädtisches Quartier mit > 100 Wohneinheiten | ○ | ○ | ○ | ○ | ○ | ◉ |
| Randstädtisches Quartier mit < 100 Wohneinheiten | ○ | ○ | ○ | ○ | ○ | ◉ |
| Randstädtisches Quartier mit > 100 Wohneinheiten | ○ | ○ | ○ | ○ | ○ | ◉ |

**Wie wirksam sind Maßnahmen des Parkraummanagements (weniger Stellplätzen, höhere Gebühren) zur Reduzierung des privaten Pkw-Besitzes in den jeweiligen Quartieren?**

| | Sehr wirksam | Wirksam | Mäßig | Gering | Nicht wirksam | Keine Antwort |
|---|---|---|---|---|---|---|
| Innerstädtisches Quartier mit < 100 Wohneinheiten | ○ | ○ | ○ | ○ | ○ | ◉ |
| Innerstädtisches Quartier mit > 100 Wohneinheiten | ○ | ○ | ○ | ○ | ○ | ◉ |
| Randstädtisches Quartier mit < 100 Wohneinheiten | ○ | ○ | ○ | ○ | ○ | ◉ |
| Randstädtisches Quartier mit > 100 Wohneinheiten | ○ | ○ | ○ | ○ | ○ | ◉ |

Block D

TECHNISCHE UNIVERSITÄT DARMSTADT

# Teil D: Kombination Maßnahmen 1

Im Kontext von Mobilitätskonzepten werden häufig mehrere Maßnahmen kombiniert um durch Synergien eine höhere Wirkung zu erzielen. Stellen Sie sich dazu vor, dass Sie für die Mobilitätskonzeption der vier unterschiedlichen Quartiere jeweils ein Maßnahmenpaket aus der vorgegebenen Auswahl zusammenstellen sollen, um den ruhenden Verkehr zu reduzieren.

*Tipp: Verkleinern Sie den Zoomfaktor von Ihrem Browserfenster (60-70%) für eine bessere Übersicht.

**Welche drei Maßnahmen würden Sie auswählen um den ruhenden Pkw-Verkehr im Quartier zu reduzieren?**

Bitte wählen Sie max. 3 Maßnahmen aus.

| | Mobilitätspauschalen | Mobilitätsstationen | Car-Sharing | Lastenrad-Sharing | Bike-Sharing | Fahrradgaragen | Verkehrsberuhigende Maßnahmen | Parkraummanagement | Quartiersgaragen |
|---|---|---|---|---|---|---|---|---|---|
| Innerstädtisches Quartier mit < 100 Wohneinheiten | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

| | Mobilitätspauschalen | Mobilitätsstationen | Car-Sharing | Lastenrad-Sharing | Bike-Sharing | Fahrradgaragen | Verkehrsberuhigende Maßnahmen | Parkraummanagement | Quartiersgaragen |
|---|---|---|---|---|---|---|---|---|---|
| Innerstädtisches Quartier mit > 100 Wohneinheiten | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

| | Mobilitätspauschalen | Mobilitätsstationen | Car-Sharing | Lastenrad-Sharing | Bike-Sharing | Fahrradgaragen | Verkehrsberuhigende Maßnahmen | Parkraummanagement | Quartiersgaragen |
|---|---|---|---|---|---|---|---|---|---|
| Randstädtisches Quartier mit < 100 Wohneinheiten | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

| | Mobilitätspauschalen | Mobilitätsstationen | Car-Sharing | Lastenrad-Sharing | Bike-Sharing | Fahrradgaragen | Verkehrsberuhigende Maßnahmen | Parkraummanagement | Quartiersgaragen |
|---|---|---|---|---|---|---|---|---|---|
| Randstädtisches Quartier mit > 100 Wohneinheiten | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**Optionale Frage: Gibt es weitere, hier nicht genannte Maßnahmen , die Sie in Kombination für besonders wichtig erachten, um den ruhenden Pkw-Verkehr im Quartier zu reduzieren?**

Max. 150 Zeichen.

Zurück

Weiter

Block E

## Teil E: Kombination Maßnahmen 2

Nun zur vorletzten Frage !

**Welche drei Maßnahmen würden Sie auswählen, um eine Verlagerung vom Pkw zu Fuß, Rad und ÖPNV in den Quartieren zu fördern?**

Bitte wählen Sie max. 3 Maßnahmen aus.

| | Mobilitätspauschalen | Mobilitätsstationen | Car-Sharing | Lastenrad-Sharing | Bike-Sharing | Fahrradgaragen | Verkehrsberuhigende Maßnahmen | Parkraummanagement | Quartiersgaragen |
|---|---|---|---|---|---|---|---|---|---|
| Innerstädtisches Quartier mit < 100 Wohneinheiten | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

| | Mobilitätspauschalen | Mobilitätsstationen | Car-Sharing | Lastenrad-Sharing | Bike-Sharing | Fahrradgaragen | Verkehrsberuhigende Maßnahmen | Parkraummanagement | Quartiersgaragen |
|---|---|---|---|---|---|---|---|---|---|
| Innerstädtisches Quartier mit > 100 Wohneinheiten | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

| | Mobilitätspauschalen | Mobilitätsstationen | Car-Sharing | Lastenrad-Sharing | Bike-Sharing | Fahrradgaragen | Verkehrsberuhigende Maßnahmen | Parkraummanagement | Quartiersgaragen |
|---|---|---|---|---|---|---|---|---|---|
| Randstädtisches Quartier mit < 100 Wohneinheiten | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

| | Mobilitätspauschalen | Mobilitätsstationen | Car-Sharing | Lastenrad-Sharing | Bike-Sharing | Fahrradgaragen | Verkehrsberuhigende Maßnahmen | Parkraummanagement | Quartiersgaragen |
|---|---|---|---|---|---|---|---|---|---|
| Randstädtisches Quartier mit > 100 Wohneinheiten | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**Optionale Frage: Gibt es weitere, hier nicht genannte Maßnahmen, die Sie in Kombination für besonders wichtig erachten, um eine Verlagerung vom Pkw zu Fuß, Rad und ÖPNV in den Quartieren zu fördern?**

max. 150 Zeichen

Zurück

Weiter

Block F

## Teil F: Herausforderungen im Quartier

**Welche Herausforderungen sehen Sie zurzeit als entscheidend bei der Umsetzung von Mobilitätsmaßnahmen auf Quartiersebene an?**

Max. 250 Zeichen.

Zurück

Absenden